VOL. XXX. CLEVELAND, O., NOVEMBER 24, 1904. NO. 21.

Naval Architects and Marine Engineers.

The twelfth annual meeting of the Society of Naval Architects and Marine Engineers convened on Thursday morning last in the auditorium of the Society of Mechanical Engineers, No. 12 West Thirty-first street, New York. It was one of the most successful meetings ever held by the society and was called to order promptly at 10 o'clock by President Francis T. Bowles. One of its distinguishing acts was to elect Sir William White, formerly chief constructor of the British navy, to honorary membership. Mr. Charles H. Haswell, the dean of the engineering profession of the United States, who is now in his ninety-seventh year, was also present and showed remarkable vigor for a man of such extreme years. He looks and acts fully twenty years younger than his actual age. Rear Admiral George Wallace Melville also attended for the first time in several years.

Naval Constructor W. J. Baxter, the secretary, read his annual report which was the first order of business. The report, dealing with the year ended Nov. 1, 1904, showed a membership of 884, divided as follows: members, 449; associates, 291; juniors, 133; life members, 5; life associates, 3; honorary members, 1; honorary associates, 2. This shows a decrease of twelve in the membership since the last annual report. The total receipts during the year amounted to $11,926.28, to which is to be added a balance on hand at the close of last year of $3,648.64, making the total sum $15,574.92. The expenses of the year were $14,154.71, leaving a balance on hand of $1,420.21. The society's present worth is $20,072.10. It has no liabilities and the following resources: Membership fees, $3,198; due from dealers for volumes, $583.98; publications on hand, $4,604.53; office furniture and equipment, $163; cash in bank, $1,362.31; cash on hand, $57.90; bond, $5,102.38; certificate of deposit, $6,000; total resources, $21,072.10.

The annual address of President F. T. Bowles, which was full of meaning, is given below in full. It will be found that he is in favor of extending aid to American shipping in the foreign trade and points to the fact that only one merchant ship is building either on the Atlantic or Pacific coasts of the United States. His address is as follows:

"I shall occupy your attention for a few minutes only, as the interesting and extensive program of papers will occupy all your available time. The condition of your society continues to be good, and notwithstanding the continued depression in ship building and the recent increase of membership dues, our society maintains a total membership of 884, and its financial condition is satisfactory and sufficient for its present modest means. The year is notable from the complete demonstrations afforded by the Russo-Japanese war of the value to a nation of the command of the sea. Japan went to war for a cause considered necessary to her existence and yet a war which could never have been thought of without the possession of a powerful fleet—battleships and armored cruisers. The efficiency of these types has been amply shown.

"The burning of the excursion steamboat Slocum with appalling loss of life will no doubt result in revision of the laws and administration of the steamboat inspection service, as already indicated in the prompt action of the administration at Washington. The subject is one of great importance, involving large property and trade interests, as well as legal and technical questions of the most intricate character. It no doubt requires treatment from a fundamental basis, but this treatment should be deliberate, should be taken only after careful study of the best practice, the ultimate effect of all measures and the means of their application. With this object in view it is gratifying to note the generally conservative tone of the report of the president's commission. We have all known for years past the necessity for this revision, and all the many efforts towards it have been rendered ineffective by statute laws, which were obsolete and inadequate to present conditions.

"While destructive fires on shipboard are of, fortunately, most rare occurrence, owing to the seamen's natural necessity for orderliness, neatness and regular inspection of all parts of his ship, it will prove a fruitful source of study for the naval architect to consider the employment of non-combustible materials within the very restricted limits which cost, weight and habitability of ships necessarily impose.

"No encouragement can be derived from the contemplation of the ship building returns for a year, showing but one merchant steam vessel of moderate size building on either ocean for deep sea traffic. It is a satisfaction to note that, after a dull year on the lakes, the conditions of traffic have again filled the lake ship yards with orders for larger and improved cargo vessels. No such prospect is before the coast and the future there seems to depend largely upon the action of such public sentiment as may have been aroused by the current investigation of the merchant marine by the congressional commission now in session and soon to report. Whatever action may result there are one or two things which are apparent to all:

"1. The naval architects and marine engineers of the United

States have demonstrated their ability to produce the best battleships, armored cruisers and submarine torpedo boats in the world. Our product of naval material in all its branches of ships, engines, boilers, electrical appliances, guns, torpedoes and armor is unexcelled.

"2. This development is the result of the public demand for a navy, and the conclusion follows that if the people want a merchant marine they can have one of the same quality. We can build as well and the prospect is also as cheaply as anyone, if we have practice and time for development and organization. Many arts prove it.

"3. To establish an ocean-going merchant marine, owned and operated by Americans, requires some present aid from congress."

President Bowles temporarily relinquished the chair while Secretary Baxter announced that the council had decided to recommend the re-election of the present officers. The body thereupon unanimously elected Mr. Bowles president and Naval Constructor W. J. Baxter secretary and treasurer.

Then followed the reading of names of new members and associates. They were all elected by the society. The list follows:

LIST OF MEMBERS AND ASSOCIATES.

Members—Warren Taylor Berry, assistant superintendent marine construction, New York, New Haven & Hartford River railroad, New York; William J. Drew, instructor in naval architecture, California School of Mechanical Arts, San Francisco, Cal.; William McNeall Howell, superintending engineer, Eastern Ship Building Co., New London, Conn.; Horace Thompson Sloan, Jr., chief draughtsman, floating equipment, Pennsylvania railroad, Jersey City, N. J.; Charles Gordon Curtis; Lawrence Stowell Adams, naval constructor, U. S. N., Union Iron Works, San Francisco, Cal.; Willis Gorman Dodd, president, Union Iron Works, San Francisco, Cal.; James Donald, naval architect, New York Ship Building Co., Camden, N. J.; James Oliver Duke, assistant superintendent, Kensington Shipyard Co., Philadelphia, Pa.; Edward Stamford Samuel Hough, engineer surveyor, Bureau Veritas, San Francisco, Cal.; Frank Jeffrey, vice-president, Union Iron Works, San Francisco, Cal.; Charles M. Jones, draughtsman, Municipal government, New York City; William Joseph Luke, naval architect, John Brown & Co., Ltd., Clydebank, Scotland; Henry Lysholm, superintendent of hull construction, New York Ship Building Co., Camden, N. J.; John H. Macalpine, naval architect and consulting engineer, 4504 Pine street, Philadelphia, Pa.; Percy Howe Middleton, vice-president, H. f. Crandall Co., 102 Bates street, East Boston, Mass.; William Brackett Stearns, naval architect, Marblehead, Mass.; Amasa Trowbridge, adjunct professor mechanical engineering, Columbia University, New York; George Warrington, superintendent of construction, United States lighthouse establishment, Washington, D. C.; James C. Wallace, president American Ship Building Co., Cleveland.

Associates—Hans George Hebbinghaus, commander Imperial German navy, naval attache, German embassy, Washington, D. C.; Edward Murray Speakman, engine draughtsman, Fairfield Ship Building Co., Glasgow, Scotland; William Cuiver Davids, mechanical and constructing engineer, 242 Donaldson avenue, Rutherford, N. J.; James Speirs Dickie, draughtsman transport service, San Mateo, Cal.; Fields Seeley Pendleton, manager Pendleton Bros., ship builders, Belfast, Me.; William Allison Fuller, estimate clerk, New York Edison Co., 55 Duane street, New York; Alonzo Gartley, general manager, Hawaiian Electric Co., Honolulu, H. I.; Henry S. Grove, president, The William Cramp & Sons S. & E. B. Co., Philadelphia, Pa.; Andreas Petrus Lundin, Pacific Mail Steamship Co., San Francisco, Cal.; Fred McQuesten, vice-president, the George McQuesten Co., 27 Kilby street, Boston, Mass.; Louis Horatio Turner, surveyor, Bureau Veritas, San Francisco, Cal.

Juniors—Arthur H. Sherwood, draughtsman, League Island navy yard, League Island, Pa.; N. S. Snow; Reuben B. Clark, naval architect, E. H. Godshalk & Co., Philadelphia, Pa.; Harold Mason DeGraw, draughtsman, office of superintending constructor, Newport News S. B. & D. D. Co., Newport News, Va.; Walter Cook Keenan, draughtsman, department of construction and repair, naval station, New Orleans, La.; Everett Parker Lesley, graduate student, Cornell University, Ithaca, N. Y.; Granville Smith, hull draughtsman, Maryland Steel Co., Sparrow's Point, Md.; Arthur Osborne Roberts, draughtsman, bureau of construction and repair, navy department, Washington, D. C.; John Hilbrish Wells, secretary, the Matthews Boat Co., Buscom, O.

Promotion from Associate to Member—George Eugene Barrett, leading draughtsman, New York Ship Building Co., Camden, N. J.; Theodorus S. Bailey, draughtsman, Holland Torpedo Boat Co., 11 Pine street, New York; Henry Capdevielle, leading ship draughtsman, navy yard, Brooklyn, N. Y.; John D. Beurel, naval constructor, U. S. navy, bureau of construction and repair, navy department, Washington, D. C.; Thomas Murritt Dick, professor of mechanical engineering, College of Agriculture and Mechanical Arts, West Raleigh, N. C.; Godfrey L. Smith, draughtsman, Newport News S. B. & D. D. Co., Newport News, Va.; Charles Franklin Willard, instructor of marine engineering, Massachusetts Institute of Technology, Boston, Mass.

Promotion from Junior to Member—Charles H. Godbold, Jr., draughtsman, Union Iron Works, San Francisco; Robert Stanley Haight, assistant to superintendent, Old Dominion Steamship Co., New York; Clifton Yeomans, draughtsman, Union Iron Works, San Francisco, Cal.

Promotion from Junior to Asociate—Axel E. Zetterman, draughtsman, Blake-Knowles Pump Works, Cambridge, Mass.

Full lists of vice-presidents and members and associates of the council follow:

Vice-Presidents—Washington L. Capps, U. S. N., Charles H. Cramp, Robert D. Evans, U. S. N., Frank L. Fernald, U. S. N., Philip Hichborn, U. S. N., Frank E. Kirby, Charles H. Lorenz, U. S. N., George W. Melville, U. S. N., George W. Quintard, Charles W. Rae, U. S. N., Edwin A. Stevens, Stevenson Taylor.

Members and Associate Members of Council—W. Irving Babcock, W. H. Brownson, James E. Denton, George W. Dickie, William F. Durand, W. D. Forbes, Charles R. Hanscom, Nat G. Herreshoff, Ira N. Hollis, William H. Jacques, John C. Kafer, U. S. N., Frank B. King, Joseph H. Lennard, U. S. N., W. M. McFarland, Jacob W. Miller, Albert P. Niblack, Lewis Nixon, Cecil H. Peabody, Walter A. Post, Harrington Putnam, Horace See, E. Platt Stratton, David W. Taylor and George E. Weed.

Executive Committee—Washington L. Capps, Lewis Nixon, Harrington Putnam, Edwin A. Stevens, Stevenson Taylor and William J. Baxter, U. S. N.

LIST OF THOSE PRESENT.

Following is the list of members of the society who were present either at the meeting or at the banquet:

H. L. Aldrich,	J. F. Bruton,
Darwin Almy,	C. H. Buckelew,
J. J. Amory,	G. H. Bull,
J. R. Andrews,	C. S. Butts,
A. E. Arby,	W. L. Capps, U. S. N.,
W. I. Babcock,	H. Capdevielle,
Joseph Barre,	A. B. Cassidy,
George H. Barrus,	W. C. Church,
W. I. Barry,	George Clarke,
W. J. Baxter, U. S. N.,	A. L. Colby,
L. L. Bernier,	W. B. Cowles,
F. L. Bigelow,	D. H. Cox,
J. M. Blankenship,	George L. Craig,
F. T. Bowles, U. S. N.,	Clinton H. Crane,

E. S. Cramp,
F. H. Cross,
N. Cushing,
Richard Deming,
W. H. Deming,
Joseph De Rycke,
Wm. D. Dickey,
W. De W. Dimock,
Wm. A. Dobson,
J. B. Edson,
E. H. Ewertz,
M. Fargusson,
F. L. Fernald, U. S. N.,
E. P. Field,
Andrew Fletcher,
Wm. H. Fletcher,
W. D. Forbes,
D. E. Ford,
H. L. Gantt,
Geo. N. Gardiner,
Geo. N. Gardiner, Jr.,
J. Howland Gardner,
H. G. Gillmor, U. S. N.,
Lieut. W. G. Groesbeck,
Robert Haig,
R. S. Haight,
Thomas S. Hall,
F. Hanford, U. S. N.,
F. L. Hand,
J. F. Hanscom, U. S. N.,
J. A. Hargan,
W. H. Harrison,
R. P. Hart,
Charles H. Haswell,
John Haug,
F. D. Herbert,
H. C. Higgins,
W. E. Hill,
Gustav Hillman,
J. B. Hoover,
Com'dr Wm. Hovgaard,
W. D. Hoxie,
Chas. E. Hyde,
Edward Hyde,
John S. Hyde,
J. Jonson,
J. H. Jonties,
S. S. Jordan,
John C. Kafer,
Jacob Katzenstein,
L. Katzenstein,
L. Katzenstein, Jr.,
William Katzenstein,
O. B. Keller,
J. W. Kellogg,
W. L. Leland,
T. C. Le Pine,
P. Leventhal,
T. P. Lewis,
O. B. Libby,
J. H. Linnard, U. S. A.,
John Lloyd,
L. D. Lovekin,
Com. Chas. H. Loring,
A. J. Maclean,
Geo. W. Magee,
H. A. Magoun,
A. MacN. Main,
Charles W. Martin, Jr.,
James W. McCormack,
W. M. McFarland,
H. L. Meeker,
E. M. McIlvain,
George W. Melville,
Thomas Meseran,
J. W. Miller,
Spencer Miller,
Thos. I. Miller,
R. C. Monteagle,
D. G. Moor,
Chas. D. Mosher,
Geo. Muller,
M. Murray,
L. J. Nilson,
J. J. Nolan,
Geo. L. Norton,
D. C. Nutting,
B. F. O'Connor,
E. E. Olcott,
A. A. Packard,
C. E. Paine,
Geo. I. Palmer,
N. F. Palmer,
Wm. F. Palmer,
W. J. Parslow,
J. V. Paterson,
C. P. Paulding,
F. C. Pendleton,
E. P. Platt,
John Platt,
W. A. Post,
W. F. Powers,
H. G. Prout,
H. H. Raymond,
E. S. Richardson,
E. P. Robinson,
R. H. M. Robinson,
A. A. Roberts,
H. B. Roelker,
C. B. Rowland,
T. F. Rowland,
T. F. Rowland, Jr.,
A. H. Sabin,
S. Sabri,
Prof. H. C. Sadler,
C. L. Seabury,
Horace See,
F. B. Slocum,
A. R. Smith,
A. G. Smith,
C. S. Smith,
H. H. Smith,
John A. Smith, U. S. N.,
L. Y. Spear,
E. Platt Stratton,
Wm. P. Stephens,
Col. Edwin A. Stevens,
A. W. Stahl,
Geo. Stanbury,
Anson P. Stokes,
Donald Stuart,
Sinclair Stuart,
James Swan,
D. W. Taylor, U. S. N.,
Stevenson Taylor,
A. D. Thresher,
C. C. Thomas,
G. R. Tuska,
F. A. Verden,
C. M. Wales,
C. M. Wales,
Charles Ward,
Geo. H. Waters,
H. C. Watts,
Geo. E. Weed,
C. P. Wetherbee,
F. M. Wheeler,
George E. White,
H. N. Whittlesey,
J. W. Wierdsman,
Henri Wilkinson,
Henry Williams,
W. C. Williamson,
L. J. Wilson,

READING AND DISCUSSION OF PAPERS.

Immediately following the election of new members and associates the business of reading and discussing the papers submitted was taken up. The first paper read was upon the subject "Simple Methods in Warship Design a Necessity," by George W. Dickie. In the absence of Mr. Dickie the paper was read by Secretary Baxter. Mr. Dickie has always contributed interesting papers to the transactions of the society and this one was no exception. This paper cannot well be briefed and will therefore be given in full in a later issue of the Review.

It was expected, of course, that there would be vigorous discussion upon this paper and there was. Naval Constructor D. W. Taylor, who led the discussion, said that in a technical paper prepared for a technical society personalities should not be indulged in, but he felt that in this particular instance they were justified. Anyone who did not know Mr. Dickie would consider him from the paper to be of a sour, sneering temperament, a miserable pessimist, whereas in fact he was full of the milk of human kindness and was by nature a most cheerful optimist. He felt that the paper showed in instances that Mr. Dickie had not been able to keep down his optimism. He agreed with the title—that there should be simplicity in warship design. He thoroughly sympathized with him in his drainage scheme but could not agree with him in the details of working it out. Personally he thought that the best thing to do was to leave out two-thirds without any radical change of the present system.

"Suppose," said he, "that Dickie's ship should meet an uncharted rock and knock a large hole in Dickie's subway for drainage, the captain would find that he couldn't get the water out except by bailing and would make a straight line for the nearest port."

Naval Constructor Taylor found a number of objections with Mr. Dickie's idea of a central passage. He maintained that as it extended nearly 400 ft. and dipped down in some places nearly to the keel one could not proceed on the assumption that it would not be damaged. He thought also that those assigned to operate the air and water valves in the central passage would have jobs worse than the slaves of old. He maintained that the passage would be insufferably hot and that it possessed one objection that in itself was prohibitory—a bursting steam pipe would fill the central passage with steam and cripple the ship until the steam could be turned off and the passage cooled. He also thought that the fumes from a shell exploding in the passage duct would stupify two-thirds of those on board. He agreed with Mr. Dickie that it would be well to abolish voice pipes which are unsatisfactory but disagreed with him that the telephone had reached such a stage of perfection that it could be substituted for that system. He also thought that his device for coaling the ship would never be used but once.

Capt. William Hovgaard of the Danish navy, now a professor at the Massachusetts Institute of Technology at Boston, sympathized with the general desire to simplify the warship but thought that the scheme of a central passage was dangerous in that it approached so near to the keel of the ship and was liable upon impact to become flooded with water. He thought the system of drainage carried on by the French to be the best. He thought the English system of handling boats the best and that the plan proposed by Mr. Dickie was too cumbersome. He also related that the Japanese in the present war had found cylindrical boilers troublesome and that the Belleville water-tube boilers had given no trouble whatever. Water-tube boilers, he said, can easily be swept at sea.

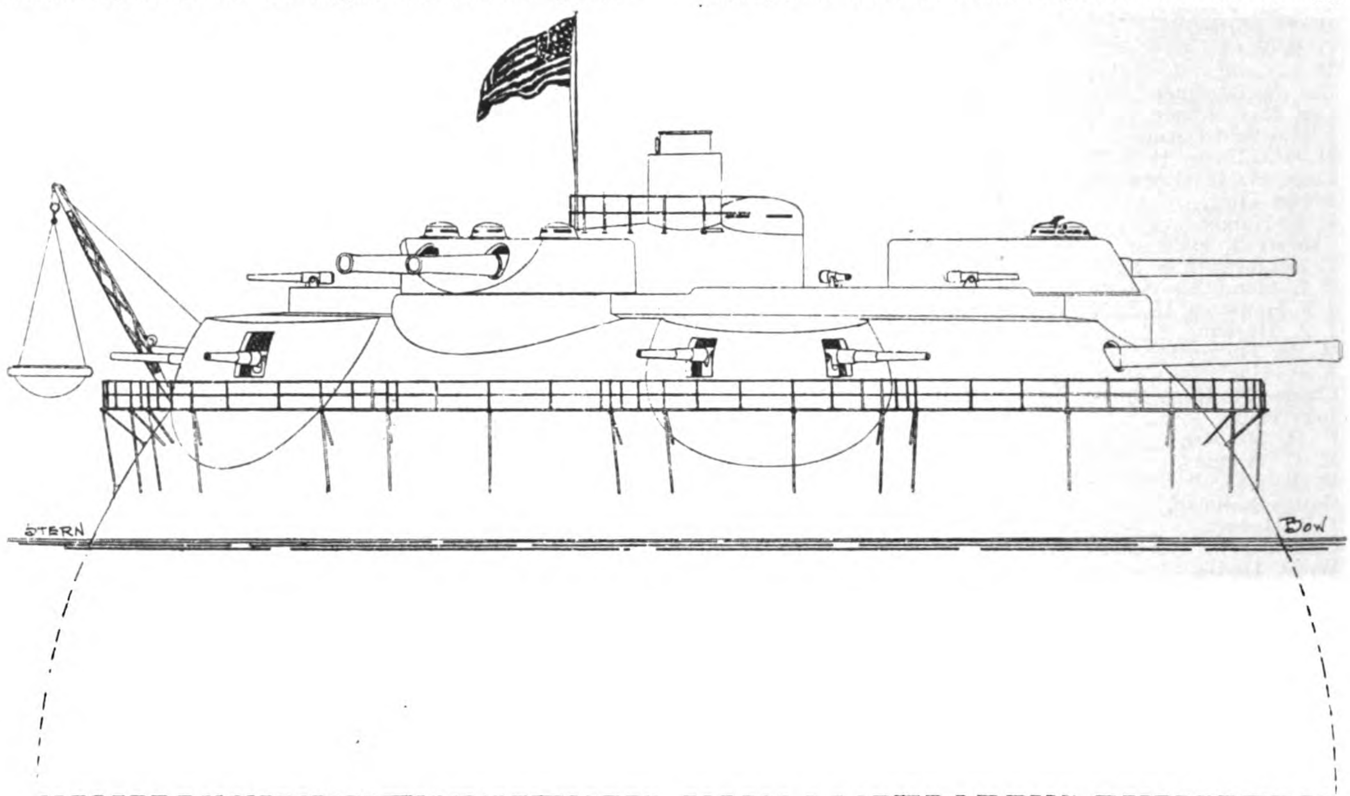
Mr. J. R. Andrews referred to the subject of electric power for both steering gear and windlasses. He said the steering gear had arrived but that probably the navy department would welcome a solution of the windlass question. Up to the present time he held it not to be safe to discard steam power for this particular machine.

In reply Mr. J. W. Kellogg of the General Electric Co. said that his company stood ready at any time to furnish apparatus to operate windlasses. He thought Mr. Dickie in his paper had not allowed sufficient power to run the auxiliaries and advocated a simpler installation of wires on shipboard.

Mr. Andrews in reply hoped that Mr. Kellogg would relate how electricity might be used when the maximum weight is not fixed, as in boat cranes and winches. He then recited an attempt to operate the capstan of the Russian battleship Retvizan, built at Cramps, by electricity. The operator could not feel the load and when the strain came it was sufficient to break the chain.

Mr. Kellogg replied that he thought the end might be obtained by making the cylinders on the windlass the same diameter as the cylinders on the generators.

Mr. J. G. Winship thought that on the subject of feed water heaters experience did not support Mr. Dickie's opinion—that better results were obtained with a feed water heater by keeping the boiler tighter, as the saying is.



OUTBOARD PROFILE OF SEMI-GLOBULAR NAVAL BATTERY CERBERUS.

MR. ANSON PHELPS STOKES' PAPER.

The second paper read was upon the subject of "The Semi-Globular Naval Battery," by Mr. Anson Phelps Stokes. Mr. Stokes was formerly the vice commodore of the New York Yacht Club and his ideas on a floating naval battery came to him while cruising at home and abroad. The gist of his paper follows:

"I have invented a vessel which is not only an impregnable coast defense ship, but a most powerful battleship, and able to go long distances. I was led to this invention partly by seeing, while yachting in the Caribbean, a remarkable little island called Diamond Rock, one mile off the southwest coast of Martinique. It is about 800 ft. square, 574 ft. high, and with precipitous sides. Diamond Rock was formerly rated as a sloop-of-war on the books of the British admiralty. In January, 1804, Sir Samuel Hood laid his seventy-four gun ship Centaur close alongside this rock, to the top of which he made fast a hawser on which was a traveler. He then hauled three long twenty-fours and two eighteens to the top and left them in charge of Lieutenant Maurice, with one hundred and twenty men and boys, with ammunition, provisions and water. The crew built a cistern. For fifteen months this novel sloop-of-war did great injury to the French shipping going to and from the neighboring harbor, now called Fort-de-France, until June 1, 1805, when she surrendered, for want of powder, to a French squadron of two seventy-fours, a corvette, a schooner and eleven gunboats. In this engagement the stone sloop-of-war Diamond Rock killed and wounded seventy men and destroyed three gunboats, with a loss to herself of two killed and one wounded. See Kingsley's 'At Last,' and 'Naval Chronicles,' vol. xii, p. 206.

"Letters patent, No. 724,756, dated April 7, 1903, were granted to me for a globular naval battery, which I described in an illustrated pamphlet giving designs for a globular battery to be called the Trident, 115 ft. in diameter, and 11,337 tons displacement at 40 ft. draught at deep load water line.

"This year the patent office has ordered letters patent to issue to me for numerous improvements in globular and semi-globular batteries. My globular and semi-globular naval batteries are also patented in Great Britain, France, Germany, Italy and Austria. I will now explain my designs for an improved semi-globular naval battery to be called the Cerberus, which is larger, more powerful, has heavier armor, less draught and greater stability, also special protection against torpedoes and submarine boats. These plans are the result of much study, calculation, draughting and consultation with experts.

WEAK POINTS OF EXISTING BATTLESHIPS.

"The reports of naval operations in the Russo-Japanese war have given us more accurate knowledge as to the weak points of the best existing battleships. That the flooding of a compartment distant from the center, and where there is little armor, gives a dangerous change of trim; that they are readily destroyed by torpedoes; that their length and shape make them very liable to be rammed and to ram their friends, and that the range of their largest gun is not sufficient to enable them to operate at a sufficient distance from mines, fortifications, etc.

"Germany has 40 caliber 11-in. guns as her largest guns on her largest battleships. All the great naval powers, except Germany, have now adopted 12-in. to 12.2-in., and not ex-

ceeding 45 calibers, as their largest guns on their largest battleships. It is found that larger guns, unless made too short, are too heavy for turrets on battleships of present width; and when mounted, as they all are, on trunnions, they will droop at muzzle if long.

"My system of elevating great guns, by shifting the center of gravity of the whole vessel, permits the use of very much larger and longer guns with stronger chases, longer chambers, and proper muzzle swells and without gun carriages. Recoil tubes may, however, be used. My system of regulating azimuths by revolving the vessel horizontally does away with the need of turrets and barbettes for these very large guns.

"The designs herewith show on gun deck two 15-in. guns of 60 calibers, but 16-in. or larger guns could be carried. The three turrets have each two 12-in. guns 50 calibers, all capable of being trained forward, and at least four of these 12-in. guns can be trained in any direction at the same time. There are eight 6-in. Q. F. guns Am. mark VI, 25 ft. long, in the four galleries on gun deck, and numerous smaller guns on upper deck. Some of the gallery guns might be larger than 6 in.

"Additional guns are to be placed on upper deck, and on promenade deck. There are six submarine torpedo tubes, four forward and two aft. The diameter of semi-globular battery Cerberus at base is 180 ft. (These batteries when as large as this, in order that they may not draw too much water, have to be more flattened at bottom than do smaller ones, which may be of many sizes, the smallest being nearly a sphere and carrying only one gun.)

"Height from base of battery to top of armored portion of smokestack, 90 ft.; to top of conning tower, 84 ft. Draught with full load, 36 ft.; at light load, 30 ft. Displacement at 36 ft. draught, 24,650 tons.

"A tube runs vertically through the middle of battery. The upper part of tube is a smokestack; the lower part is a chute for discharging ashes and other refuse. Below the bottom of tube there is a space shaped like the frustum of a cone. This space is to hold a great mushroom anchor, having vertical holes for the passage of ashes, etc. The gun deck is thoroughly ventilated and lighted by three sliding hatches on deck level, and three sliding hatches over the torpedo hoists, also by the central tower, and by numerous gratings and small piercings through the armor, etc. All stairs and landings in central tower and many of the other stairs are gratings. There are also openings for ventilation under seats on upper deck and on gun deck and inside of bulwarks, and in circular bulkheads; and transom windows open over gun deck and over the three passages to promenade deck, which are on same level as gun deck.

"A watertight annular compartment, marked counterpoises, occupies the outer part of berth deck. It contains tracks on which are moved heavy weights to tilt the vessel. It is accessible only by two ladders in watertight trunks, or pipes, extending above gun deck. Water ballast may be used to aid in tilting vessel.

INDEPENDENCE OF THE DIVISIONS.

"The remainder of the vessel, or battery, below gun deck, is divided by radial bulkheads into three watertight main divisions, viz. starboard, port, and after main divisions. All these main divisions are carried up to gun deck, which is 18 ft. 3 in. above load water line at deep draught.

"Each of these main divisions has a complete outfit of boilers, engines, coal, stores, water, ammunition, pumps and other machinery, including means of propulsion, steering, and the movement of its own turret, etc. The machinery for pumping, ventilation, electricity, water distilling, etc., in each main division is available and sufficient for all main divisions. Each of the main divisions is divided by watertight bulkheads and decks into numerous watertight subdivisions, as described below.

"The subdivisions are marked by large open-faced letters A, B, C, D, E, F, G, H, I. These subdivisions do not communicate with each other except that there are watertight manholes at foot of 15-in. hoists, and between A and certain watertight cells for coal and water and stores, etc., in C and I. One cell in hold in each main division is added to A to be used for chains, etc. With this system of watertight main divisions, subdivisions and cells, and of counterpoises, and with tanks for water ballast, if a number of subdivisions and cells were filled with water, the battery could still be kept afloat and on an even keel, and could continue to manœuver and fight as a complete vessel, for she is practically three double vessels in one.

"The cubic contents below load water line at 36 ft. draught is 862,750 cu. ft. (This is after deducting for central tube and for anchor space.)

"The cubic contents of zone between load water line and gun deck is 347,450 cu. ft. (This is the reserve buoyancy up to gun deck.)

	Cubic feet.
A contains in starboard main division............	94,300
A contains in port main division.................	94,300
A contains in after main division................	98,150
B contains in each main division 50,800 cu. ft. x 3.=	152,400
C (divided into watertight cells) contains in each main division 8,400 cu. ft. x 3.................=	241,200
D (divided into watertight magazines, etc.) contains in each main division 36,133 cu. ft. x 3........=	108,400
E contains in each main division 14,617 cu. ft. x 3.=	43,850
F, G and H each contain 20,883 cu. ft. x 3......=	62,650
I contains the fresh-water tanks inside of outer bulkhead on lower deck............................	22,950
The annular compartment marked counterpoises contains	32,750
The armor and backing and the double bottom and double sides, cellulose, etc., below gun deck contain	259,250
Total cu. ft.	1,210,200

"This equals 34,577 tons, which would be the total displacement if the vessel were submerged up to gun deck. Belt, average thickness, 18 in. Measuring on slope of vessel it extends 15 ft. above and 17 ft. below load water line at 36 ft. draught, and completely covers sides of berth deck and magazine deck and parts of main deck and lower deck. It is thickest near water line, where it is 21 in. Sides above belt, 15 in; sides below belt, 2 in to 4 in.; average, 3 in.; turrets, barbettes, central tower, conning tower and gun galleries, 15 in. on sides and 4 in. on tops; bulwarks, 6 in.; stack, 6 in.; upper deck, 4 in.; berth deck, 1 in.; sloping splinter bulkhead in gun galleries, 1 in. to 2 in.; underside of lower deck beams, 2 in.; outer circular bulkhead running from base to berth deck, average 2 in.; bottom, 1 in. The great mushroom anchor, when up, further protects central portion of battery.

"No vessel afloat has anything like such protection. Only a vessel of more or less globular form could carry anything like such weight of armor. It is also to be noted that the sides are all circular, and the portions above water very sloping, so that projectiles would glance. The Cerberus is planned to carry a weight of armor equal to 48 per cent. of its displacement at load water line. No existing battleship carries more than about 25 per cent.

BOUNDARIES OF WATERTIGHT SUBDIVISIONS IN MAIN DIVISIONS.

"A contains all the space in central tower on main deck outside of central tube, and all the space bounded by the main deck, the lower deck, the central tube and anchor space and

the main circular bulkhead, and contains also about half of the space on lower deck between the main circular bulkhead and the outer circular bulkhead, also one cell in hold. Subdivision A contains complete outfit of boilers and machinery.

"B contains all the space on main and berth decks outside of main circular bulkhead (exclusive of counterpoise compartment and of tanks under gun galleries.) Some of these outside tanks might be used for oil.

"C contains all the space on lower deck between the outer circular bulkhead and the frame of the vessel, also all the lower hold excepting one cell in hold in each main division. C has numerous watertight cells for coal, water ballast, cellulose packing and stores.

"D contains all the space on magazine deck outside of main circular bulkhead. D is composed of watertight compartments each of which is accessible only through its own watertight hoist extending to gun deck.

"E contains the space on main deck between outer wall of central tower and main circular bulkhead. E communicates only with gun deck.

"F contains three-eighths of the space in starboard main division on lower deck, between the main circular bulkhead and the outer circular bulkhead. F is accessible only through a watertight hoistway, extending above gun deck.

"G contains on port side the space, etc., corresponding to F.

"H contains in after main division the space, etc., corresponding to F.

"I contains the fresh water tanks on lower deck.

"Subdivision A in the after main division has 600 H. P. in boilers and engine. The other main divisions have each 400 H. P. Under ordinary circumstances, when not in action nor moving from port to port, the engines in the starboard and port main divisions would not be used, or the engines in after main divisions would not be used. The 15-in. hoists having watertight manholes at bottom are to be used for taking machinery in and out. The placing of the gun galleries and their guns balances the heavy guns forward, or water ballast may be used to complete balance. The partially spherical shape of the gun galleries and the rotary mobility of the vessel facilitate the use of small ports and strong close-fitting shields. These galleries may be used for ward room, library, mess room and smoking room, or for hammock space if needed.

THE CERBERUS HAS LITTLE MANEUVERING POWER.

"As the purpose of the Cerberus is defense rather than aggression, it is not necessary that it be able to move rapidly from one place to another. Small power would be sufficient to work the screws or other mechanisms which rotate the vessel or move it slowly from place to place, and to operate heating, water distilling, ventilation, ice and electrical plants, etc. Thus, there is much saving in the consumption of coal and in the weight and space required for machinery. This saving, added to the more important feature of the semi-globular shape of battery, enables heavier armor and more guns and a longer supply of coal to be carried; and the Cerberus equipped with water-distilling plants could remain at sea for many months without needing any supplies whatever. There is room on board for a large force of men. The gun deck, including gun galleries and platform, provides much hammock space. But a small force would be sufficient fully to equip her on a war basis, while in times of peace she could be maintained at small expense.

"The speed may be increased somewhat by a change in form of bottom as shown by the broken lines on the inboard profile plate. Should the Cerberus need to move quickly to a distance, an armored cruiser might find useful and safe employment in towing her. The two vessels might sometimes be used together as a small squadron. One such semi-globular battery could defend or blockade an important strait; could protect the mouth of a transcontinental canal, or dominate almost any large seaport, and could safely resist more than a dozen of the largest battleships which cost $7,500,000 apiece.

"'The best battleship will be the one that can remain longest in the stress of action, not the one that can most quickly get into a fight or get out of it.' Admiral O'Neill, chief of ordance bureau. Quoted with approval by Messrs. T. A. Brassey and John Leland in Naval Annual, 1903.

"Our largest battleships, the Connecticut, Louisiana, etc., 16,000 tons, have no gun heavier than 12-in., and cost $7,500,000 each. They are 450 ft. long, their main armor belt is 200 ft. long and 15¼ ft. wide, and 11.4 in. thick over a breadth of 5 ft. in the middle; it tapers to 9 in. at lower edge, and the upper strake (7 ft. broad) is 6 to 5½ in. thick. The largest British battleship, King Edward VII, 16,350 tons, has 9 to 8-in. armor or belt, 8 to 7-in. on side, carries 950 tons of coal, and has no gun heavier than 12-in., and cost £1,420,206 sterling. Her main armor belt is 260 ft. long.

"For many straits and harbors, globular or partially globular batteries would be much less expensive than land fortifications; and more efficient because so much nearer to attacking vessels, and safe from any hostile army. Besides, the naval powers know the exact positions of the large guns in our coast fortifications, but the Cerberus could change its position. Even if it should be thought best to place it on the bottom in shoal water it would still be impregnable, and its 12-in. and smaller guns could continue to fight. The roll of the Cerberus in a gale would be very slight. The metacentric height is great. The stability of buoys of a similar shape is well known. Armor on bulkheads, decks, and under lower deck beams make, practically, small armored vessels inside a larger one. These provisions, combined with the cellular and double armored construction, and the strong cellular construction of the coal and water ballast tanks, together with the coal, afford defense against torpedoes. All magazine and handling rooms, shell rooms and torpedo rooms have also cellulose exterior bulkheads. Further use of cellulose may be made in connection with the double construction of sides and bottom. The boilers, machinery and magazines are particularly well protected. The doors to turrets are largely protected by the armored central tower, the doors to which are largely protected by the turrets.

"A 36-ft. launch and smaller boats are carried on gun deck under protection of the armor. Submarine boats could be thus carried under the armor by having the after passage on gun deck a little higher. There are six large derricks for anchors, boats, submarine boats, mines, etc.

"The Cerberus is three impregnable battleships in one. What a difference one such vessel would have made at Port Arthur! How much expense and loss avoided! How many lives saved! How easily the Cerberus could have sealed up Santiago, Vladivostock, or Port Arthur! When the great struggle comes for the control of the windward passage, that key to the Carribean and to the Panama canal, which we may be called upon to defend, the existing type of battleship may be found insufficient, and land fortifications and mines will not suffice, for the windward passage is wide and deep, as are also the other entrances to the Carribean sea."

DISCUSSION OF MR. STOKES' PAPER.

In discussing Mr. Stokes' paper Capt. William Hovgaard said that Denmark at one time proposed the building of floating forts but concluded later that it was preferable to build on shore. A small island was constructed outside Copenhagen at a cost of about $2,000,000 and equipped with 14-in. guns. He said that no matter how seemingly impregnable a floating fort might be it was liable to destruction at any time by submarine mines and torpedoes. He thought also that the idea

of training the guns by turning the whole ship round was very awkward.

Col. Edwin A. Stevens confessed to a liking for floating batteries. They had been used at Gibraltar and also by the French in the Crimean war. If a vessel isn't really able to run away from anything or to catch anything, even if only slightly deficient in these particulars, she might for practical purposes be totally so. He doubted therefore whether it was wise to build monitors which have slight speed and which have not the offensive and defensive powers of battleships. It was a question whether it would not be better to build floating forts than monitors. He suggested the sinking or grounding of a floating fort in New York harbor. True, it would not be exactly a floating fort, but it could be lifted at some expense and moved elsewhere.

COM'DR NOVGAARD'S PAPER "THE SEAGOING BATTLESHIP."

The concluding paper at the forenoon session was by Com'dr William Hovgaard upon the subject "The Seagoing Battleship." It is impossible in the present issue to deal more completely with this paper than to summarize it but it will be dealt with later. Briefly Com'dr Hovgaard's ideas were as follows:

"The present paper is an attempt, on basis of general principles, to arrive at the type and size of warship, best suited to secure command of the ocean. First, the fundamental elements of the design—armament, speed and radius of action are shown to depend on the work which the ship has to do, a work that varies from year to year with technical progress, political and strategical conditions, etc. These elements being chosen, it is shown how the other elements—nautical qualities and protection, follow from those and from conditions on the ocean as a logical consequence of the aforesaid general principles. The result does not indeed differ greatly from recent battleship designs, although important modifications are proposed, but, whatever the conclusion, it is believed that such a discussion must always be of interest, since it aims at basing the design on fundamental and unchangeable principles instead of on current practice or personal views. It appears that only by placing the design on such basis is it possible to avoid the vascillations in ship building policy, under which many navies have suffered, and only on such basis is it possible without error to discern the true direction which progress must follow under the present rapid development.

"It is imperative, just at the present time, that we should carefully consider this question of the best type of battleship, for not only have the means of attack lately been considerably improved, but recent war experience has thrown light on their use, which with many people has shaken the faith in the existing type.

"The improvements referred to in the means of attack are:

"1. Increased penetrative power of guns, due to higher velocity and improvement in the metal of projectiles, and to the use of caps. Thus the 12-in. gun has gained about 25 per cent in penetrative power since 1901.

"2. Advance in gunnery.

"3. Development of the submarine boat and the torpedo.

"The Russo-Japanese war has brought out the fact that submarine attack both by mines and torpedoes has been far more frequently successful than anticipated, although it cannot be asserted that the effects of such attack have exceeded what might have been expected.

"Hence it has been argued that it is unreasonable to construct ships representing a capital of some eight millions of dollars, which it takes several years to build and which carry a crew largely made up of trained experts, representing years of costly education, if such ships are quite frequently exposed to almost instantaneous destruction.

"Notably the armor appears to many of little value, since it is useless in case of submarine attack and since it is unable to keep out the projectiles of modern guns. Their conclusion is that it would be better to abandon or reduce the armor protection and build vessels of small or moderate displacement since thereby the loss of the individual ship would be of less consequence, and the greater number of units would reduce the chances of loss for each ship. This idea was embodied in the principles of 'la jeune école' in France already in the eighties, and has recently been advocated by so eminent an authority as the late Vice Admiral Makaroff.

"As shown in the following such revolutionary policy of ship construction is likely to prove fatal to any power for whom command of the ocean is under certain contingencies of war a necessity.

"It is shown that for service on the ocean the largest class of battleship offers the best combination of military and nautical qualities, and that hence for a given expenditure the greatest fighting value is obtained with this type. Smaller ships of whatever class, necessarily deficient in some or all of the essential qualities, will be unable to drive the large ships from the sea.

"It is admitted that for coast work the large battleship is less suited now than formerly, although, as shown in this paper, its power to resist submarine attack may be greatly improved. It seems advisable to entrust the coast defense and attack chiefly to smaller ships of special types, and to use the sea-going battleships for this service only in case of urgent necessity and then only with greatest caution. This implies virtually a restriction in the sphere of action and hence in the importance of battleships, but there is still a long step to the abandonment of the type.

CONSTITUTE PRINCIPAL FIGHTING STRENGTH.

"The sea-going battleships constitute the principal fighting strength on the sea; they form the nucleus of naval power, and to them all other types of sea-going warships are subsidiary, serving chiefly for their assistance and protection. The type that is to fulfil this function must be essentially a fighting ship, and should be able to engage all classes of vessels without ever being placed at a disadvantage. It should be able under certain circumstances to fight forts and shore batteries.

"It should be capable of use both for offensive and defensive duties, and must generally be designed to operate all over the world. It should therefore have sufficient seagoing capability for continued ocean service and possess a great steaming radius. The speed must be such as not to place it at a disadvantage compared with battleships of other navies, nor should it fall below the speed of battleships of the same navy.

"Without yet assigning quantitative values to the elements which make up the fighting capacity, we may state as a first general principle that the all round use to which this class of vessel is to be put renders it necessary to fulfil each of the claims to seaworthiness, armament, protection, speed and endurance in a harmonious way, so that no one of these elements shall be unduly favored at the expense of the others.

"If a sea-going battleship is deficient in any one of these important qualities, even although she may excel in one or more of the others, she is liable, at one time or other, to be placed at a serious disadvantage, namely when matched against an opponent, in which these nautical and military qualities are more harmoniously balanced, even if the opponent is not of greater displacement.

"This principle has always been followed in all successful battleship designs, but the repeated advocacy of smaller specialized types implies a doubt of its validity, which makes it necessary to further explain and prove the principle by showing that the various elements of a design are organically connected.

"Another important principle follows from the all round

duties of the battleship, namely, that the design should in every respect be based on 'probable average conditions' and not on exceptional contingencies. This principle is indeed likewise generally conformed to, consciously or unconsciously; the difficulty in applying it lies in determining what may be fairly considered average conditions, but since a logical design seems impossible without such basis, it is necessary to make an estimate of them, a point which has received careful consideration in the following.

"It may at first sight appear that principles and propositions are stated in this paper which are mere truisms, not worthy of statement and still less of proof or discussion. Consideration will show, however, that past history affords examples of the violation of even the most fundamental of such principles, and, moreover, that if we are to form a comprehensive conception of a problem so intricate as the design of a battleship, it is necessary that all arguments bearing on the solution should be stated and the proper weight assigned to them.

"The type of battleship here proposed is but a modification of the Connecticut and King Edward classes. Provided the premises of this discussion are correct and the arguments sound, it was indeed to be expected that the result should agree essentially with the best recent designs, and more particularly with those which have not been restricted in displacement by financial considerations. The modifications proposed, although of great importance, are stepwise in character, and follow as a natural consequence of recent changes in means and methods of warfare. The principal points are:

"Complete substitution of semi-heavy guns for the quick firers of secondary batteries, and consequent installation of all secondary guns in turrets, preferably twin turrets, placed on main deck.

"Greater subdivision of engine power by triple screws.

"Use of oil fuel by mixed combustion.

"Greater metacentric height and hence somewhat greater beam.

"Abandonment of center line bulkhead except where necessary between engine rooms.

"Both inner bottom and wing passage bulkhead to be fitted along the sides. Greater distance of lateral bulkheads from side.

"Wing spaces arranged as compensating tanks for righting the ship.

"Side armor to maintain midship thickness and height to extreme end of magazines, where the transverse armor bulkheads should be placed.

"Lighter protection of barbettes below main deck.

"Only one armor deck.

"We have arrived at the proposed type on basis of specified conditions. It has been shown how the qualities required to meet these conditions are interdependent, and how, therefore, only one solution can be the best, namely, that which is consistent with the organic relations existing between the different elements of the design. In the battleship so designed we may say that the qualities are harmoniously balanced, since no one is unduly favored at the expense of the others, and each is present in a sufficient measure. This solution has necessitated a displacement equal to that of the largest battleships now building. As shown in the paper, this is due to the fact that the large ship, apart from its superiority due to higher speed, greater gun-power, and better protection, is inherently superior to the smaller in point of nautical qualities, watertight subdivision, economy of propulsion, and relative sea-speed. These qualities cannot be attained in the same measure in a smaller ship, and, since they are not subject to addition, they cannot be compensated for by a greater number of units. The deficiencies will be greater the smaller the ship.

"Let us imagine a squadron of smaller ships matched against one of the larger ships of same aggregate displacement. The superior speed and gun-power will enable the larger ships on one hand to effect concentrations at close range on part of the enemy's force, and on the other to carry on the fight at distances, where, although still able to destroy the weaker ships, they will themselves be practically immune against their artillery. We have here assumed a general inferiority of the smaller ship; if we assume a partial inferiority, involving a departure from harmonious design, the deficiency may not be apparent on all occasions, but in the length of time it is likely that the chances of war will bring the ship in a position where the quality in which it is deficient will be of great and even vital importance, and the defect may then prove fatal. The adoption of a smaller type of battleship than that necessary for the complete fulfilment of all the claims stated at the beginning of this paper, must, therefore, be regarded as a retrogression.

"On the other hand, it is admitted that great concentration on large units is undesirable on account of the dangers by submarine attack and ramming, for although the margin of safety is greater in the larger ship, the inducement to such attack increases with size, and the risk of grounding also increases with size. This consideration puts an upper limit to size, namely, that found just sufficient for fulfilment of the claims. Hence it would be unwise either to fall below or to exceed that displacement of the sea-going battleship, found above to be necessary and sufficient for the due performance of its work.

"It must be borne in mind, that as basis for the design here proposed, it has been assumed that the service of the sea-going battleship lies chiefly on the open sea, only exceptionally involving direct attack on fortified ports. This has necessitated the great claims to nautical qualities, and also, since the watertight subdivision here proposed seems fairly adequate under these conditions, it has justified the large displacement.

"When we come to consider coast war in a narrow sense—harbor attack and defense, blockades, etc.—the case is different. Recent developments in submarine attack has rendered such work exceedingly dangerous, and this service is moreover accompanied by exceptional risks to larger vessels by grounding and collision. Although the larger ship is better able to stand such damage, it must be admitted that smaller ships have here distinct advantages; their smaller draught and greater manœuvering power make them more handy and less exposed to the dangers of grounding and collision, the smaller value of each unit makes it justifiable to run risks which should not be incurred with large ships, and their smaller power of resistence to submarine attack is probably more than outweighed by their greater number. Moreover, on account of reduced claims to nautical qualities, speed, radius of action and living accommodations, small size may, in coast defense ships, be combined with great offensive and defensive power.

"As a result of recent developments we have, therefore, to admit a limitation in the use of the sea-going battleship, and an increased necessity for the construction of special artillery vessels for coast war. Such vessels, ranging from the Arkansas to the Henri IV, already exist, only the type must be chosen in accordance with the special requirements of the case, and developed to meet the changed conditions, but a study of this question lies outside the scope of this paper."

COM'DR HOVGAARD'S PAPER DISCUSSED.

Naval Constructor J. H. Linnard said that Commodore Hovgaard's paper showed that complications are necessarily involved in the design of a battleship and that he had set forth his ideas most clearly.

Rear Admiral George Wallace Melville, formerly engineer-in-chief of the navy department, said that he found nothing to condemn, much to commend and little to criticise in the paper, and that as one of the hard hitters in favor of triple

screws for battleships he was glad to know that he had the backing of Prof. Hovgaard.

President Bowles, who was formerly the chief constructor of the United States navy, took occasion to say that the paper would bear thorough study, especially by those who had been engaged in actual battleship construction. He declared it to be especially satisfactory to himself that the second armored deck, a feature of British ships, had been omitted, and added that the omission of this deck had been the most efficient means of giving offensive power to American battleships.

Adjournment was then taken for lunch.

THURSDAY AFTERNOON'S SESSION

The first paper read at Thursday afternoon's session was Naval Constructor D. W. Taylor's paper upon the subject, "Some Recent Experiments at the United States Model Basin." It is obviously impossible to comprehensively deal with a paper of this character in limited space owing to the impossibility of reproducing the drawings. Conclusions will, therefore, only be dealt with. Mr. Taylor's paper was as follows:

"The experiments which are the subject of this paper have been under contemplation at the experimental model basin for some time, the design, construction, and testing of the necessary apparatus and appliances having necessarily extended over a considerable length of time. The experiments themselves are quite recent, the first regular test of a model propeller having been made in August last. The primary object of the experiments was the determination of the power and efficiency of model propellers of the ordinary three-bladed type throughout the range of pitch ratio and blade area likely to be encountered in practice. In view, however, of the present tendency towards increasing speed of revolution of propellers, the experiments were extended to the unusually low pitch ratio of .4. The series of experiments covered thirty model propellers. They were all 16 in. in diameter, three-bladed, of uniform pitch, diameter of hub 3 1/8 in., thickness of center of blade at the root 9-32 in., at the tip 3-32 in. The pitches used were six in number, namely, 6.4, 9.6, 12.8, 16, 19.2, and 24 in. For each pitch five widths of blade were used, the mean width ratios, actual total blade area and blade area expressed as a fraction of the disc area, being as indicated in the table below. The propellers were of composition and were cast at first from wooden patterns, but afterwards it was found simpler to use plaster of Paris patterns. They were finished as to the face in a special machine, described in Appendix 'A.' The backs of the blades were finished by hand and both backs and faces were carefully smoothed with emery cloth before the tests. The dynamometer apparatus and methods used for making tests are described in Appendix 'B.' The methods of reduction of the tests are described in Appendix 'C.' The results were carefully faired by cross-curves and propellers whose curves did not fair in satisfactorily were carefully retested. I now invite your attention to the final results of the experiments.

TABLE OF PROPELLER VARIABLES.

	Pitch Ratio						Mean width ratio	Total developed area Sq. inches	Developed area ÷ Disc area
	.4	.6	.8	1.0	1.2	1.5			
Propeller Number	1	6	11	16	21	26	.075	24.28	.1207
	2	7	12	17	22	27	.125	40.46	.2012
	3	8	13	18	23	28	.200	64.74	.3220
	4	9	14	19	24	29	.275	89.02	.4427
	5	10	15	20	25	30	.350	113.30	.5635

"The 16-in. propellers experimented with are materially larger than any previous model propellers concerning which I have knowledge. Froude's model propellers, experimented with about twenty years ago, were 8.16 in. in diameter Prof. Durand's experiments, described in volume 5 of our Transactions (1897) were made with propellers 12 in. in diameter. A 16-in. propeller tested as these were is by no means a toy. Each propeller was tested up to a thrust of 150 lbs. or a slip of 40 per cent. The propellers of the coarser pitch did not show 150 lbs. thrust with 40 per cent slip, but they did show 100 lbs. at the highest speed experimented with. The finer pitched propellers reached 150 lbs. thrust at slips materially less than 40 per cent for the higher speeds of advance.

"After the runs the propellers were carefully tested on the machine described in Appendix 'A' for variation of pitch. In no case was there any appreciable distortion of pitch. The five propellers of one pitch ratio were also tested for pitch in the machine with a weight of 50 lbs. hung to each blade from its center at a radius of 2-3 the maximum radius of the blade. Some of the narrow blades bent a good deal under this test, but did not change pitch appreciably at any point and took no permanent set.

"It may be well to point out the fundamental elements affecting the powers and efficiencies of propellers. They are the diameter, the pitch, the blade area and the shape of blade section. The latter is seldom referred to or included as a fundamental feature in propeller design, but these experiments indicate clearly that it is a thing which must be reckoned with, and that probably many unsolved puzzles in connection with propellers have been dependent upon shape of the blade section. The conventional meaning of the word 'pitch,' as applied to a propeller of uniform pitch, is the pitch of the driving face or helicoidal face. The back of the blade, however, also has a pitch at each point, and in the conventional section it varies from point to point. If the water always remains in contact with the back of the blade as well as the face of the blade, it would seem obvious that the pitch of the back of the blade necessarily affects the operation of the propeller. It is not generally realized how widely the pitch of the back of the blade varies from the face. It is seen that for propellers of .200 mean width ratio and a uniform pitch on the face of 16 in., the pitch of the back varies from 7.8 in. to 26.4 in. Conventionally we call the pitch of this propeller 16 in., but it is obvious that it is practically impossible to know what the real pitch is. While it is the primary object of this paper to lay before the society actual results of comprehensive experiments which each member may analyze for himself, rather than to set forth theories of my own. I wish to direct attention to a few features of these results which appear worthy of remark and requiring explanation In the first place we have been accustomed for many years to suppose that the maximum efficiency of the propeller varied but little from 70 per cent. These experiments show a maximum efficiency of propeller No. 28 of 78.8 per cent. While as described in Appendix 'B' the efficiencies do not take account of the hub action, and are hence slightly higher throughout than if the hub action had been considered, I am confident that the high efficiencies were actually obtained. It will be noted that these model propellers are more accurately finished and the blades are comparatively thin, the thickness at the root being .018 and at the tip .006 of the diameter. There is a steady falling off in efficiency as the pitch ratio is decreased. This was to be expected from theoretical considerations.

"Perhaps the most remarkable feature of these results is the disclosure of the fact that as the pitch ratio is decreased the influence of the area of blade upon the results become progressively less until for the propellers of very fine pitch ratio the narrow blades actually absorbed the greater power. For the propellers of .6 pitch ratio, curiously enough, at a slip of 26 per cent it makes practically no difference what the width of blade is, the same power is absorbed by the propeller, although the narrow blades show somewhat greater efficiency. Below this slip the narrower blades absorb the greater power,

just as for the .4 pitch ratio, while above this slip the wider blades take more power. As pitch ratio is increased this action becomes less and less, until for the higher pitch ratios experimented with the power absorbed is greater the wider the blade. The increase in the power with increasing width of blade is, even for the higher pitches, however, much less than it should be according to propeller theories of which I have any knowledge.

"Another remarkable feature is the fact that as the pitch ratios of the propellers decrease the power absorbed and efficiency at low slips are both very great, the slip being based upon a conventional pitch.

"Thus considering the series of propellers from Nos. 6 to 10 it is seen that for the narrowest blade the efficiency at zero slip is 66.8 per cent, while the maximum efficiency of this propeller is but 67.4 per cent. As the blade width is increased this effect is decreased. Of course an explanation of many of the features above described is the fact already pointed out that the slip based upon conventional pitch is necessarily erroneous. It would seem that the real or effective pitch of the propeller was a quantity which varied very much. For small slips the effective pitch would seem to be very much greater than the nominal pitch, whereas for large slips it would seem to become less again. In other words, at small slips the propeller acts as if the following portion of the back of the blade was predominant, whereas at large slips it acts as if the leading portion of the back of the blade assumes predominance.

CAVITATION.

"It is generally recognized that model propeller experiments are of little value as regards cavitation owing to the fact that model propellers working under the combined pressure of the air and water have a virtual submergence very much greater than that of full-sized propellers. For many of the propellers experimented with there seemed to be a tendency towards reduction of thrust and torque when tested at the 7 knot speed, but there was no pronounced cavitation observed, except in the case of No. 1 propeller when tested at 7 knots. Most of the propellers of this pitch ratio were tested up to 6 knots only. Fig. 10 shows curves of thrust and torque plotted upon slip for propeller No. 1 for 5, 6 and 7 knots speed of advance. The 5-knot curves are normal. The 6-knot curves show evidences of cavitation at about 0 per cent slip and 115 lbs. thrust. The 7-knot curves show strong evidences of cavitation at about — 15 per cent slip and 80 lbs. thrust.

"It will be noted that cavitation occurred at a very low thrust per square inch of projected area, about 4.3 lbs. for the 7-knot speed, and that the thrust at which cavitation became marked was about 40 per cent greater at 6 knots than at 7 knots. I feel very confident that in the case of this particular propeller the breaking down, which we call cavitation, while affected by the thrust, was strongly affected by two other factors, namely, the speed of revolution and the shape of the blade section. In other words, in this particular case the breaking down of the propeller was a case of cleaving the water as when one draws a stick through water, and at a sufficiently high speed of revolution the propeller would have shown cavitation with almost no thrust. It seems reasonable to suppose that all cavitation is largely of the same nature and a function not only of the thrust but of the speed of revolution and shape of blade section, and that it could probably be mitigated in many cases, or deferred by modifying suitably the blade section."

DISCUSSION OF NAVAL CONSTRUCTOR TAYLOR'S PAPER.

Commodore Hovgaard felt especially grateful to Mr. Taylor for his painstaking research as manifested in the paper. Referring to the fact that the efficiency of the propeller falls off as the low pitch ratio increases he thought the paper especially valuable in any consideration of the turbine engine. It is well known that the turbine has greater efficiency at high speed and that there must be a certain speed below which it will not pay to use turbines instead of reciprocating engines.

Col. E. A. Stevens declared that it would be impossible to digest the matter of the paper in many days. He was struck with the immensity of the ground covered which can well be appreciated when it is understood that Mr. Taylor in his experiments varied both the area and pitch.

Naval Constructor Linnard said that he had always wanted to know what cavitation looked like with its dreadful results on efficiency, and related that he one day went to the model basin to watch Taylor's experiments. He had an idea that the water was sucked down from the surface through lack of pressure at the back of the blade but was surprised to find that when cavitation occurred there was no disturbance whatever on the surface of the water. The visible evidence of it was that the screw was followed by cloudy water in a somewhat cylindrical shape. He thought probably it was a gaseous condition. He hoped Mr. Taylor would continue his experiments with four-bladed propellers.

Replying to Commodore Hovgaard's observation that efficiency falls off as low pitch ratio increases he thought something might be done to prevent this by altering the back of the blade. He will make further experiments to determine this.

President Bowles asked Mr. Taylor whether he had made any comparisons with regular and model propellers. To this Mr. Taylor replied that he was not prepared to answer at this time as a regular propeller, attached to a ship, is driving the ship ahead and sucking it astern at the same time.

President Bowles said that Mr. Taylor's paper was the most valuable that had been presented to the society for a number of years and the society accordingly extended thanks to Mr. Taylor for it.

PERFORMANCE OF TORPEDO BOATS.

Lieutenant L. H. Chandler's paper upon the subject, "Some Further Notes on the Performance of the Torpedo Vessels of the United States Navy at Sea," was read by Mr. D. H. Cox. Mr. Chandler's paper contained data in the form of tables of the destroyer trip from the east coast of the United States to the Asiastic station with which, of course, it is impossible to deal. His observations of life on board these small vessels is, however, interesting and will be published later.

Mr. C. P. Wetherbee of the Bath Iron Works, Bath, Me., said that Lieut. Chandler had done more to bring torpedo boats in repute than any man in the United States navy. He said that the wedge formation of a flotilla looked difficult—that is the bow of one boat touching the stern of another while traveling at the rate of 15 knots per hour, but that Lieut. Chandler had successfully accomplished it.

Naval Constructor J. M. Powells' paper upon "The United States Armored Cruiser Colorado," will be given in full in a later issue. It was read by Mr. D. H. Cox in the absence of Mr. Powell.

Mr. Spencer Miller's paper, too, upon "Coaling Warships at Sea," will be given attention in a later issue. In his preface Mr. Miller said that the first cableway was a land cableway, plus a towing engine. Towers have now been eliminated because the spars of the ships are used and the towing engine has been eliminated because the winches are used and that it is altogether a far more seamanlike device than formerly.

Discussing the paper Commodore A. G. Boutakoff of the Russian navy said that he had heard the Lidgerwood-Miller device criticized in this country owing to its lack of simplicity. He admitted that there was nothing a sailor loved more than simplicity but that there could be no real progression if simplicity should always be the deciding factor. He thought the device could be operated with profit on the high seas

and that the sailors would speedily become accustomed to it.

This concluded the first day's session.

SECOND DAY'S SESSION

President Bowles Leaves the Chair and Enters with Spirit Into the Discussion—A Number of Valuable Papers Read.

The second day's session was animated by President Bowles who frequently left the chair to take part in the discussion himself. He is a most agreeable and incisive speaker and compels attention by his manner.

The first paper at Friday morning's session was by Admiral Melville upon "Time Allowance for Steam Yacht Races." Admiral Melville was compelled to leave and the paper was read by his business associate, John H. MacAlpine. Mr. MacAlpine very truly said that as it was a mathematical paper it was impossible to brief it. He thought the best brief was contained in the introduction and that he read as follows:

"When I was asked by Commodore S. Nicholson Kane, chairman of the regatta committee of the New York Yacht Club, to formulate, on behalf of his committee, rules for the Haouli cup races, I failed to find any previous discussion of the subject and thus was forced to break new ground. It seems to me that, in a yacht race, the questions under test are the intelligence of design and construction and the excellence of seamanship of the various competitors. Hence, the object of a time allowance is to annul the advantages, arising purely from physical laws, of increased size or change in the proportion of the dimensions and of the power installed. These are the principles which have guided the deduction of the formula for time allowance.

"But it is evident that any such formula must depend on more or less arbitrary assumptions, and consequently there is ample room for difference of opinion and discussion. Any rule which is formulated is sure to bear hard on some one. For clearness, and to facilitate the exact understanding and discussion of the paper, I have noted all the principal assumptions. Some of these are more of the nature of conventions. Others, while not expressing exact laws, are sufficiently near the truth to serve the sportsmanlike purposes of the race, and their use leads to rules which are very simple in form. An exactly fair rule, were it possible to frame it—which I do not believe—would be so excessively complex as to be worthless and make a great toil of what is intended for pleasure.

"So far as I can see, the proposed rules are very fair for yachts of serviceable dimensions. If the beam and draught are excessively reduced in proportion to the length, a heavy time allowance is demanded; but, as will appear, not so much as the advantages gained for speed in a smooth sea, demanded. If the race is to demonstrate possibilities of valuable service, in times of peace or war, such exceptional yachts should be discriminated against even more heavily than I have done, as they are not good sea boats and their speed would very rapidly fall with a rising sea. Many of them could not safely be sent far from port.

"The deductions given here are only for races where full speed can be used from start to finish. For very long races, where the limits of bunker capacity would preclude full speed being used, the time allowance would have to be settled by other considerations.

"In framing the rules care has been exercised to use only those measurements which can be made readily and with accuracy; thus only length of water line, beam, mean draught, and grate surface are required. Such measurements as those of displacement and cœfficients of fineness are difficult to make from the finished ship and might give rise to troublesome disputes. Besides, any measure which would involve the shape of the lines, as those of displacement and fineness do, should be avoided, as we then trench on the proper sphere of the designer. If on given dimensions of length, breadth, and depth he has, by excellence of judgment and fulness of knowledge, produced a superior yacht, he should get all the advantage arising therefrom, and not be discriminated against. If the extra speed is gained merely by greater length, increase of engine power, or reduction of breadth, he should be brought to a level with other designs of equal intelligence, where different dimensions have been chosen."

Mr. H. de B. Parsons regarded Admiral Melville's paper as a most able enunciation of principles for steam yachts for racing purposes. The rating given is not exact, nor is it intended to be. It would indeed be impracticable to give an exact rating. He referred to the race of the Kanawha and Haouli last May when the two yachts steamed 60 knots and finished four minutes apart. The time allowance was figured at 4 1-10 minutes which made them practically equal. Owners of steam yachts are frequently prepared to spend any amount of money to win a race and the tendency is to make the sport therefore dangerous. He thought some rules should be adopted to minimize this tendency because he had objection to having the judges' boat used for life-saving purposes. The chief factor is horse power and freak designs are produced to float the greatest power possible. He also referred to the difficulty experienced in determining the indicated horse power.

Mr. W. D. Stephens thought Admiral Melville's paper most timely because the racing of power yachts is becoming more and more a recognized sport. He believed also there was need for some fixed rules for time allowances and pointed to the fact that in one race held five distinct formulæ were figured upon to the end that the actual results were not known until nine months later. He thought the great lesson to be learned was the value of some fixed rule for displacement. A designer is tempted to cut displacement when his object is the winning of a big race.

Mr. A. A. Packard thought that indicated horse power could be arrived at in three ways—measuring the coal, measuring cylinder and speed of piston or measuring propeller.

Col. Edwin A. Stevens regarded it as impossible to arrive at a rule to put unequal vessels upon an equality. From calculations of length and sail area it was supposed that a fixed rule had been established for time allowance for sailing vessels but the yacht designers speedily beat the rule out of sight. He did not think that any rules would avoid the creation of freaks. What is needed is a rule that will give the majority of vessels a fair fighting chance.

A NUMBER OF PAPERS READ.

Mr. George Stanbury, principal surveyor for Lloyds in the United States, then read his paper upon the subject, "On the Rules of Lloyds' Register for Building Yachts to Class." This paper was extremely valuable and will be given in full later.

Prof. H. C Sadler, professor of naval architecture at the University of Michigan, said that the strength of a ship should be the first consideration. Displacement should be the governing factor in all construction and he regarded the new rules as a great improvement over the old ones. He also referred to the reasonableness of Lloyds in approving new designs when the requisite strength was assured.

Mr. W. D. Stephens regarded the subject of Mr. Stanbury's paper as one whose importance is more recognized now than ever before. He thought that there should be a fixed rule limiting lightness in construction because it will sacrifice weight to gain a certain end, sometimes with safety and sometimes not. The modern racing yacht is, of course, worthless for anything except the purpose intended and he thought that there should be some limitation in the design of these craft.

In reply Mr. Stanbury said that the rules, as framed by the society of Lloyds were reasonable in all respects but were not perfect. The society was open to conviction and the amendment of its rules at all times.

Mr. D. H. Cox then read the paper contributed by Mr. L. E. Bertin of Berlin upon the subject "The Position of the Center of Lateral Resistance," which will be dealt with in a later issue.

In discussing this paper Capt. Hovgaard related an experience with torpedo boat No. 10 in the Danish navy about fifteen years ago. She was a small boat of 15 tons with the center of gravity well above the water line. Having occasion to turn sharply while going at full speed in a dead swell outside Copenhagen she heeled so greatly as to capsize and sink. The rudder area of a sister ship was then reduced 25 per cent and turning at full speed and full rudder heeled 13 degrees.

President Bowles stepped from the chair to say that he was glad such an old friend as the Center of Lateral Resistance could stir up discussion. He urged the members to enter more thoroughly into the spirit of discussion, saying that every word added to the value of the paper to absent members.

Mr. A. MacMain believed that better results would be derived if the experiments were made in the line of actual sailing. He spoke of making models of actual ships and sailing them in open ponds.

Mr. Nabor Soliani's paper upon "Subdivision of Weights in Ships' Displacement," was read by Mr. Cox. This paper will be discussed more fully in a later issue of the Review. In referring to the paper Capt. Hovgaard said that he hoped the suggestions contained in it would be acted upon. Calculation of weights are extremely important.

President Bowles, who again took the floor, said that it seemed to him in connection with this paper that no one had been more generous in disseminating information concerning weights than the navy department. Their classifications had been prepared with the utmost care and were the growth of several years. The result is that the design of new vessels proceeded along lines of certainty. He regretted that Mr. Soliani had not included in his paper the weights of some of the Italian battleships.

Adjournment was then taken for lunch.

FRIDAY AFTERNOON'S SESSION

Immediately upon assembling for Friday afternoon's session President Bowles relinquished the chair to Col. Edwin A. Stevens. The first speaker was Mr. Robert Haig who read his paper upon "Maintenance of Machinery in Merchant Ships." Mr. Haig is Lloyds' surveyor at Philadelphia and he went into his subject very thoroughly. It will be given in full later.

Mr. F. Merriam Wheeler declared the subject to be very far-reaching and was glad to see that Mr. Haig had given so much attention to condensers. The deterioration of tubes he held to be a burning question. He thought, however, that electrolysis had much more to do with stationary plants than with equipment on ship board. He attributed trouble on board rather to galvanic action and showed that deterioration was much more marked on board ships confined to New York harbor than it was on sea-going vessels. The corrosion of tubes on vessels on the Passaic river which acts as a sewage drain for a number of towns is frightful and is to be attributed to chemical action. He also thought that vessel owners as a rule were not willing to put enough money into pumps. In this regard he held the British to be far in advance of Americans because they are willing to buy higher-priced, longer-lived and more efficient pumps.

Mr. W. D. Forbes said that the government was very exacting on the rules governing electrical equipment and added that current had been delivered per kilowatt per hour on a consumption of from 9 to 31 lbs. of water.

Mr. W. N. Howell of the Eastern Ship Building Co. thought it might be well to go back to the old style of air, feed and bilge pumps driven from the cross-head. He held the consumption of water by the auxiliaries to be very great. Concerning the water-tube boilers he said that the greatest installation of a merchant ship was made aboard the Minnesota and her sister the Montana, built by the Eastern Ship Building Co. at New London, Conn. Niclausse boilers were installed on these vessels and it was his observation that more than anything else a little intelligence was called for in the fire room. He deplored the use of automatic devices for regulating the supply of water and thought that the firemen should be made to look after the water level. All such devices simply placed a premium upon laxity.

In reply Mr. Haig stated that as he went about he found that the auxiliaries are given scant attention on board ship. He thought more care should be bestowed upon them.

The next paper read was entitled, "Uniform Specifications," and was read by Mr. W. D. Forbes. It will be given attention later.

Mr. Stevenson Taylor, who had meanwhile taken the chair, said that he had been a contractor for a great many years and that he had discovered that the term "first-class" had many interpretations and had a very indefinite meaning in most specifications.

CRANE'S PAPER ON HIGH SPEED GASOLINE LAUNCHES.

Mr. Clinton H. Crane's paper upon the subject "High Speed Gasoline Launches," met with deserved attention. His creation, the Vingt-et-un II., has met with much praise. Mr. Crane's paper, which was extremely interesting, will be given in detail later.

Mr. Alpheus A. Packard's paper upon the "Speed and Power of Recent Motor Boats of Several Types," being of a somewhat similar nature to Mr. Crane's, was read before any discussion took place upon either. This paper will be dealt with in a later issue.

Prof. H. C. Sadler in discussing the papers said that the development in high speed gasoline launches has been remarkable considering the short time that has elapsed. He thought the designers somewhat ahead of the builders because he had found reluctance on the part of builders to adopt scantlings outlined by designers, fearing, owing to their lightness that the boats would not hold together.

Mr. Packard complimented Mr. Crane upon the Vingt-et-un, saying that he had produced a small boat which was less affected in rough weather than any other and that her narrow stern has not changed her trim at high speeds.

Mr. H. F. Donaldson thought that the matter of ignition at high speeds was one of the most difficult. Concerning the horse power of an automobile engine it seemed to depend largely whether one was buying, selling or making. He didn't think that the horse power of a gasoline engine could be determined because even weather conditions affected it and the same results could not be obtained day after day.

Mr. D. H. Cox regretted that Mr. Crane did not show more of the workings of the propellers. He thought also that the designers and owners are going to great expense to develop the high-speed small boat and urged the navy department to take up the subject and develop the high-speed launch in its model basin.

Mr. W. D. Stephens said that a year ago the auto boat was more in the air than in the water. It has been developed from the high-speed automobile engines of the French and Germans. All the boats so far are very largely freaks but he thought it was a question which the navy department should give attention to so that a thoroughly well thought-out boat might be developed.

In closing the discussion Mr. Crane said that if he had known that so much interest was to be manifested in his boat he would have brought a model of her along with him. He said that the Vingt-et-un did rise out of the water as her speed increased, the water contiguous to her passing was 4 or 5 in. lower than the surrounding water. He admitted that ignition was a perplexing problem as the speed increased but that a speed of 1,200 revolutions had been reached. The stern

of the Vingt-et-un is not flat but has a dead rise aft which he thought had great influence on her steering qualities. From 14 knots up there was no hump in her speed curve.

As it was growing late the concluding papers, "Recent Launching Practice on the Atlantic Coast," by Assistant Naval Constructor R. H. M. Robinson, and "Recent Launching Practice on the Pacific Coast," by Everett P. Lesley, were read only by title.

Mr. Frank W. Hibbs' paper upon "The Shipping and Ship Building of Puget Sound" did not reach the society in time to be printed for distribution.

The sessions came to an end at 5 o'clock Friday afternoon.

THE BANQUET IN THE EVENING.

The concluding feature of the meeting was the banquet at Delmonico's on Friday evening. President Bowles presided and introduced the various speakers. The principal speaker of the evening was Paul Morton, the secretary of the navy, but illness compelled him to cut his speech short and he did not say all that was in his mind. He left the dinner early. He got great applause by saying that there was a man in the white house now who believed in making the navy the greatest in the world.

"I believe in expansion," said Secretary Morton, "not only in territory but in all things. I stand for expansion as opposed to contraction. I believe in expansion not only of the navy but of our political influence, and that means the expansion of our commerce which we all want. I am in favor of a navy so efficient that no other nation will ever want to make an engagement with us."

The tenor of his brief speech was that the administration was not only in favor of upbuilding the navy but the merchant marine as well.

The health of Mr. Charles H. Haswell, who is ninety-seven years old, was drunk standing. He was chief engineer in the United States navy during the civil war.

Before introducing Commissioner McAdoo, who did not arrive until late, Rear Admiral Bowles added his voice to the demand for an increased merchant marine and better encouragement to American ship builders by the government. He declared that the policy of the government in building its war ships and providing its own system of colliers and transports was directly against the interests of ship builders and the development of a shipping industry.

Police Commissioner McAdoo and Mr. Anson Phelps Stokes also spoke. The evening was indeed most successfully spent.

LAKE FREIGHT SITUATION

The lake season is finishing in a thoroughly sound and healthy condition though the freight rate is not what owners expected. It has ruled at 80 cents from the head of the lakes during the past week and there seems to be little probability of any further advance owing to the fact that the demand for tonnage has fallen off. The Steel Corporation, which went out of the market over a week ago for wild tonnage, expects to end its season next week. Other large shippers are hoping to have all their cargoes down by the end of next week. Very little unsold ore has been brought down and in a broad way it can be said there will be no unsold ore on Lake Erie docks this winter. In other words some of the furnaces will be short of ore before the season opens next year. The Steel Corporation's reserve of ore is about as it was last year, which was approximately 3,500,000 tons. Trade conditions are undoubtedly improving and if signs indicate anything whatever much business will be done during the next two years. Better prices will be obtained for ore next season than this as higher prices have already been given for blocks of ore over the price fixed by the ore association at the beginning of the year. This will make for a better freight rate. The present year has been a less one in that respect, even the larger vessels earning only a fair return upon the investment.

Coal has been moving a little more freely than for some time past and the grain trade has been quite satisfactory.

OBITUARY

Charles Gumlich, well known as a marine engineer, died at Geneva recently as a result of an accident. He fell from a Lake Shore train at the Geneva station and was badly wounded internally.

Capt. Edward S. Chateau died at the home of his son Samuel Chateau at Parish, New York, last week at the age of 79 years. He was for many years a sailor on the great lakes and was a former resident of Oswego, N. Y.

George Lennox Watson, yacht designer, died at Glasgow last week from heart disease. As to whether Watson or William Fife, Jr., was the premier British designer of racing yachts was long a subject of dispute, but the preponderance of yachting opinion favored Watson. Probably the best known of his creations is the Britannia, owned by King Edward. This famous yacht was built while the King was Prince of Wales and remained unbeaten in her class. Among the boats defeated by the Britannia was the Vigilant, which went abroad after successfully defending the America's cup.

Shamrock II, which came nearest of the Shamrock trio to winning the America's cup, was designed by Watson, and Americans will remember that the margin between the British boat and Columbia was very close. Watson also designed the two Valkyries and the Thistle, and Capt. "Nat" Herreshoff once admitted that Watson was the one British designer of whom he was afraid.

When Watson designed the Thistle, the trim boat that caused such a panic among American yachtsmen, he was sure that he was going to win the cup. After the races were over and the cup remained safe on this side Watson said:

"I lost that cup because of my wonderful Scotch parsimony. I was afraid to spend proper money on proper sails. It saved the cup for America. It lost it for me."

Watson was born in 1851, and when only sixteen years old he was apprenticed to the Messrs. Napier, the Glasgow ship builders, and from that time he became a rival of the Fifes—first of William Fife, Sr., and later of the son, the designer of Shamrock III. At Sandbank, on the Clyde, it was an everyday sight to see both famous designers, measures in hand and clad in overalls, hurrying along to their yards. Watson's first success was achieved with a five-tonner, the Clothilde, which beat the champion Fairlie boat Pearl in a series of matches at Largs.

It was as a designer of steam yachts, however, that Watson was pre-eminent, and in this he had no equal in the world. The last notable steam yacht he designed was the Warrior, ordered by Frederick W. Vanderbilt, a boat which has not yet been seen on this side. Other well-known steam craft which Watson designed are the Delaware, the flagship of the New York Yacht Club and owned by Commodore Frederick G. Bourne; Mrs. Robert Goelet's Nahma, Eugene Higgins' Varuna, Walter Jennings' Tuscarora, Pliny Fisk's Riviera, James Gordon Bennett's Lysistrata, and Sir Thomas Lipton's well known Erin.

Some articles of wreckage of a very interesting and historic nature have just been rescued from the deep off Ballycotton bay, Ireland, after lying there for fifty-seven years. These consist of the engine pump, and engine frame of the steamship Sirius, which was the first British steamer that crossed the Atlantic and was wrecked in 1847 in the vicinity of Ballycotton, Cork. From what remained of this remarkable wreck, the articles mentioned have now been salved by Messrs. Ensor, salvage contractors, Queenstown.

National Merchant Marine League

A movement of deep significance, and doubtless of far-reaching effect was given an impetus following a dinner to Mr. Aaron Vanderbilt of New York at the Union Club in Cleveland on Monday evening of the present week. Mr. Vanderbilt has been all his life devoted to the merchant marine interests of the country and was instrumental in the formation of an industrial and shipping league as early as 1885. His unceasing and unselfish efforts also to create on the sea an adequate naval reserve similar to that which supplements the army on land met with approbation some years ago by congress when the title of honorary commander to the United States naval reserve was conferred upon him. The dinner to Mr. Vanderbilt was a spontaneous tribute to his untiring services in behalf of the merchant marine of the United States. After five hours of earnest discussion following the dinner the National Merchant Marine League of the United States was formed.

There were present at the dinner the following gentlemen:

Edward C. Plummer, Atlantic Carriers' Association, Bath, Me.; Alexander E. Brown, Brown Hoisting Machinery Co., Cleveland; Samuel W. Meek, Leader, Cleveland; A. S. Upson, Upson Nut Co., Cleveland; Capt. John Mitchell, Mitchell & Co., Cleveland; Ambrose Swasey, Warner & Swasey, Cleveland; Thomas Howell, Grasselli Chemical Co., Cleveland; John R. Russel, Russel Wheel & Foundry Co., Detroit; John Craig, Craig Ship Building Co., Toledo; A. W. Colton, Toledo; George E. Bartol, Otis Steel Co., Cleveland; J. H. Webster, Variety Iron Works, Cleveland; W. D. Sayle, Cleveland Punch & Shear Works, Cleveland; W. G. Mather, Cleveland Cliff Iron Co., Cleveland; J. E. Upson, Upson-Walton Co., Cleveland; Col. J. J. Sullivan, Central National bank, Cleveland; Harvey D. Goulder, Goulder, Holding & Masten, Cleveland; John A. Penton, Penton Publishing Co., Cleveland; S. T. Wellman, Wellman-Seaver-Morgan Engineering Co., Cleveland; Harry Coulby, Pittsburg Steamship Co., Cleveland; A. I. Findley, Iron Trade Review, Cleveland; Andrew Squire, Squire, Sanders & Dempsey, Cleveland; A. B. McNairy, president Chamber of Commerce, Cleveland; J. H. Dempsey, Squire, Sanders & Dempsey, Cleveland; George H. Cushing, Leader, Cleveland; Ralph D. Williams, Marine Review Cleveland.

Mr. Harvey D. Goulder presided at the dinner. Before introducing Mr. Vanderbilt he asked Mr. John A. Penton to read the list of regrets from those who had desired to attend the dinner but could not be present. Mr. Penton briefly summarized nearly one hundred letters from prominent merchants and manufacturers throughout the country.

Mr. Vanderbilt in prefacing his remarks said that he was deeply moved to see so sincere an interest displayed in the rehabilitation of the merchant marine in the inland state of Ohio. In part he said:

"The Phonecians were the most important ship builders and sailors of ancient civilization, originating in the Tigro-Euphrates valley and migrating to a strip of land on the eastern Mediterranean—all sea-coast—succeeding generations, born with the salt of the sea in their blood, pushing their voyages and trade to all the Mediterranean and beyond the pillars of Hercules to the western shores of Europe and Africa. Controlling the sea and the greatest power, they built their ships and sailed them to all parts of the known world. The Etruscans, Greeks and Carthagenians preceded the Romans in the control of the Mediterranean. After the decline of the Etruscans, the supremacy was contested between the Carthagenians and the Greeks, each in turn controlling the sea, and, therefore, a world-power in the lead while in control of the sea.

"Reaching down through the days of the Genoese and Venetians, we come to the Portugese and Spaniards, who divided the newly discovered world in the east and west between them, and, consequently, the riches of the world, until the ascendency of the Dutch, who controlled in the first half of the seventeenth century, when England and France, contending with her, reached the first and second positions, France finally yielding to England, who has ever since stood at the height in control of the sea power. For a brief time—from 1850 to 1861—we shared with her the supremacy, when the civil war engrossed our attention and energies within our own borders. The privateer and consequent war rates of insurance swept our flag from the sea, for at that time the over-sea tonnage of the world was divided into three parts, England possessing a fraction over one-third, the United States a fraction less than one-third, and the remaining part to the other nations of the world. Now Great Britain has some 14,000,000 tons—over one-half of the world's tonnage—while we have sunk away to a dwindled 800,000 tons, endeavoring in the chase to keep in sight the funnel smoke of the other powers. While, like the Phonecian with the mountain range of Lebanon in the rear, we like the Phonecian, had the sea in our front and the salt of the sea in our blood, with the Allegheny range in our rear; extracting from the sea and its pursuits the wealth to build a country beyond that mountain range.

"Our country now covers the broad domain of a continent, but it has lost its touch with the sea, though having 10,000 miles of sea coast, with domain at several points girdling the world. Unless we restore the normal condition of our maritime strength, which is now paralyzed, we will be the victim of our own neglect. Like a vigorous man with a paralyzed right arm, the arm must be restored at whatever cost to the normal condition, not abnormal development, but restored the arm must be, for its loss, when confronted by an enemy may cost the partial destruction of the body or perhaps its very life. The state of Ohio, the joint territory of the nation, when its limits of industry to the west was the Allegheny range, is now its potent state of the west, the cradle of our great men, and one of the greatest in the effort to restore the merchant marine of the country.

"It is fitting that a movement to restore our strength on the sea should be given vitality here; that the merchant marine, a reserve for the navy in event of hostilities, a strong right arm of the nation for its safeguard and protection, should be strengthened in every way possible.

"The American sailor has never been found wanting, when the life of the nation has been in peril; the revolution found him brave and resourceful in giving birth to the nation; in numbers excelling that of the army of Washington; in privateers and vessels of war scouring the sea, harrassing the enemy and capturing supplies and ammunition for the sustenance of the continental army; the deeds of John Paul Jones commanding respect from the nations abroad and greatly contributing to our independence. The war with Tripoli, the American sailor and ships of war dared the corsair, where other nations had feared to tread but rather submit to the extortion of tribute money.

"The war of 1812, the second war of independence, won respect and peace from Great Britain, through the valor and skill of our intrepid sailors and matchless ships. England stood aghast: For over fifty years she had lost but three single ship actions with the French and Spanish, while in the war with us she had lost fifteen out of eighteen single ship actions and two fleet actions—lost during this our second war of independence.

"With our merchant marine in the over-sea trade of 2,500,-

000 tons, register when the civil war commenced, we contributed to our modest navy of a few ships and 7,000 officers and men, 600 ships and 60,000 officers and merchant marine sailors, which proved to be the key to Appomatox and the end of our peril. Our brief war with Spain, for want of an adequate merchant marine to draw from, compelled us to scoure the seas for colliers and transports. We fortunately succeeded in securing about forty ships from foreign nations, because of the weakness of our enemy to demand the strict neutrality that a more powerful nation would have commanded. We may not be thus fortunate again. Japan's command of the sea, in her war with Russia, is the latest demonstration of the value of sea power in a nation's peril. The people of the country are becoming aroused to the humiliating condition.

"Your efforts here in Cleveland, Ohio, to aid in the restoration, and nailing to the mast the stars and stripes with 'Don't Give up the Ship,' upon its waving bunting, is potent in the accomplishment of this result, and will influence to a much greater extent than that of similar efforts on behalf of the sea coasts of the Atlantic and Pacific, where the interested industries and ship building and ship owning are more likely to be considered to some extent as that of selfish interests. Much of late has given evidence of the country's change of sentiment in this matter—sufficient to predict success to heroic effort in behalf of the cause.

"You may have reason for congratulation ere long for the effort you are putting forth that the remedy may be applied and that the right arm of sea power and influence, for both, commerce in peace and defense in war may be restored to its normal condition."

It is impossible in this issue to give the addresses of the other speakers. They all spoke from deep conviction and with extraordinary grasp of the subject. Each one was familiar with it from the standpoint of his own business; some had even made a study of it for years and what was said at the table was the concentrated wisdom of practical men. As each one present represented a different business it was clearly shown how widespread is the interest in the upbuilding of the merchant marine in the United States, for that was the road which everyone traveled, though they approached it by different avenues. The speakers following Mr. Vanderbilt were Andrew Squire, John Craig, Edward C. Plummer, A. W. Colton, Alexander E. Brown, Samuel W. Meek, Ambrose Swasey, A. S. Upson, John R. Russel, W. D. Sayle, Harry Coulby, S. T. Wellman and Col. J. J. Sullivan.

Col. Sullivan at the conclusion of his remarks offered the following resolution for adoption:

"Since nations became commercial, the carriage of products freely and uninterruptedly has been the chief source of their advancement. No nation can seek the markets abroad without the aid of ships; no nation is more sure of the integrity of its foreign commerce than that which controls it in its own ships.

"The foreign commerce of the United States has grown to the great total of $2,500,000,000 per annum, and the country's whole prosperity depends upon the undisturbed continuation and extension of this commerce. Yet it is being carried over sea today under foreign flags. The tonnage of American ships engaged in the foreign trade aggregates only 879,000 tons, while there is not today a single ship building anywhere in the United States for this trade.

"The situation is critical and calls for immediate action; for a conflict between European nations, by no means improbable, would result in the withdrawal of ships and leave us without the means of sending the products of our fields and factories abroad. Our commerce would simply back-water and close every mill and mine, and stagnate the agricultural interests of the country.

"A national association should be immediately formed to seek to remedy this condition. It should be organized from deeply patriotic motives and should be non-partisan in character. It should have for its object, solely the up-building of the American merchant marine, for two vital reasons—the first, to carry a just proportion of our own commerce in our own ships, with its coincident safe-guarding of the lanes of trade over sea, and the stimulating of the ship building industry of the United States now languishing by the handicap imposed upon it through the extension of protection to every industry except shipping; the second, to secure for the United States an adequate naval reserve, for the merchant marine service must always be the great resource of the navy in time of war.

"Resolved, That we favor the immediate formation of a national organization that shall further in every legitimate way, measures looking to the restoration of the American merchant marine to its former prominence on the high seas."

The resolution was unanimously adopted and a committee consisting of W. D. Sayle, Samuel W. Meek and Ambrose Swasey was appointed to draft a preliminary form of organization.

The committee took a recess and meanwhile the interim was occupied by a talk by Mr. Alexander E. Brown in which he predicted that six years hence the American flag would be more conspicuous in the over-sea trade of the United States than the British flag. This prediction was greeted with great applause. Mr. Brown then explained that he had made the prediction four years ago, placing it then at ten years, and was led to do so by the fact that capital having pretty well exploited the natural resources of the country would be compelled to turn to the sea. He also added that he did not believe that there were any ships engaged in ocean traffic designed upon sensible lines for the carriage of bulk freight. He believed a great revolution was bound to come on the ocean in this respect and that the lead would be taken by American brain and American capital.

The committee on temporary organization then returning to the room submitted the following preliminary by-laws for the new association:

"First: This association shall be known as the National Merchant Marine League of the United States.

"Second: It shall have for its object the restoration to the high seas, of the American flag, to the end that the interests of American commerce may be furthered and an industry whose importance as an aid to our national prosperity should be regarded as paramount, may be restored.

"Third: It shall be composed of persons, firms or corporations who believe that immediate action should be taken by our national legislature and that the rebuilding of the American merchant marine should be hereafter, as in time gone by, regarded as a national and patriotic, and not a partisan, measure.

"Fourth: The officers shall consist of a president, vice president, treasurer and secretary.

"Fifth: In addition, there shall be a vice president from every state of the union where there are twenty-five (25) members, said state vice presidents to be appointed by the president of the association, and who, together with the president, vice president, treasurer and secretary, shall constitute an executive committee with full power to act for the association in every way.

"Sixth: The dues shall be $10.00 a year and shall accompany all applications for membership.

"Seventh: The foregoing shall constitute the temporary by-laws of the association, pending a general meeting of the

organization to adopt constitution and by laws sufficient to meet all the requirements."

The by-laws were unanimously adopted and Capt. John Mitchell moved that a further committee be appointed at once to select a list of officers. However, before this motion was seconded Mr. J. H. Webster said that no person had been more active and more energetic in furthering the interests of the Merchant Marine Commission when it was in Cleveland than Mr. Harvey D. Goulder and he moved his election to the office of president. Mr. Goulder was unanimously elected and upon motion of Mr. Craig the office of vice president was unanimously bestowed upon Mr. Aaron Vanderbilt. In like manner Col. J. J. Sullivan was elected treasurer and Mr. John A. Penton secretary.

It was then long past midnight and the meeting adjourned. Steps will be at once taken to project the league into every state in the union and as the officers are all persons of great energy it is expected that a large membership will be secured by the first of the year.

ITEMS OF GENERAL INTEREST

It is reported that Capt. Charles A Davis of Somerset, Mass., the well-known ship builder, will establish a ship yard at Stonington, Mass., and will build several large schooners there.

The state of California is to construct two immense concrete docks with steel frame work at San Francisco for the use of the Pacific Mail Steamship Co. The docks will be each 650 ft. long and 140 ft. wide and will cost approximately $400,000.

The bids for completing the Mare Island dry dock, Cal., were as follows: The Scofield Co. of New York, $1,385,000; W. M. Concannon Co. of San Francisco, $1,420,000; Healy, Tibbitts & Co. of San Francisco, $1,387,000; and the Burrell Construction Co of Oakland, Cal., $1,645,000.

The French cruiser Dupetet-Thouars recently underwent a preliminary trial, lasting eight hours, in the course of which the machinery was worked at various rates of speed. The results were excellent and it is related that the performance of the Belleville boilers was all that could be desired.

The launch Lady Antoinette has been sold by Mr. Howard Keeler of New York to Mr. Harold Weston, Jacksonville, Fla., through the agency of Stanley M. Seaman, New York. The boat was shipped to Jacksonville last week on one of Mr. Weston's vessels, he being a large ship owner.

The big dredger Mexico, owned by the celebrated British engineer, Sir Weetman Pearson, will be repaired by the Risdon Iron Works of San Francisco, the contract price being $10,000. The bids of other corporations were as follows: Union Iron Works, $11,498; Union Engineering Works, $13,150; W. A. Boole & Son, $17,034; Fulton Iron Works, $24,875.

At the annual meeting of the Navy League of the United States held on Nov. 10, 1904, at the headquarters of the league, 78 Broad street, New York, twenty-three sections were represented. George DeForest Barton, New York; W. DeW. Dimock, New York; Alfred Ely, New York; Edwin S. Gill, Washington, and Aaron Vanderbilt, New York, were elected directors to serve until 1907.

At a meeting of shipping representatives recently, in the Mercantile Marine office, Glasgow, the superintendent, Mr. D. Mackenzie, on behalf of the Board of Trade, presented to Mr. Archibald Turner of Hamilton a gold watch and chain awarded by the president of the United States of America to his son, Alexander, first officer of the S. S. York Castle, for gallantry at sea. This gallant but unfortunate young man lost his life on 21st February last, while trying to save the crew of the American schooner Willie L. Newton, 200 miles from New York.

The mammoth new dry dock at the Charlestown navy yard is being slowly filled with water for tests and to equalize the pressure while the mammoth cofferdam is being removed, and this fact is attracting hundreds of visitors, all anxious to see one of the largest stone works of the kind in the world, one capable of docking the largest ship afloat or as yet projected. Already the height of the water is about 15 ft., and this will be gradually increased from day to day until the dock is full. The water is admitted at the flood of every tide, and enough to increase the depth about 18 in. flows in each time.

Following the allotment to members of the National Association of Motor and Boat Manufacturers, there still remains some space at the motor boat exhibition to be held in conjunction with the Sportsmen's Show at Madison square garden, New York, next February. This space will be given to those making first application and after it is gone there will be no more room for motor boats in the big garden during the two weeks' affair. All the space has been taken except about 200 ft. of water space. There is also 70 ft. left of motor space and five open spaces in the gallery. This will be awarded to those making the first application to J. A. H. Dressel, manager, St. James building, 1135 Broadway, New York.

The steamer Monitor, built by the Lockwood Mfg. Co., East Boston, for the city of Boston was given a builder's trial trip recently and proved satisfactory in every particular. The Monitor is 155 ft. 4 in. over all, 25 ft. beam and 9 ft. 3 in. deep. The hull is of wood with steel trusses and watertight bulkheads. She is of the latest side-wheel type but without the walking beam of the earlier boats. Two steel trusses are built in the vessel to give additional longitudinal strength and stiffness. The entire bottom of the vessel to a height of 6 ft. above the water line is sheathed with copper. The main engine is of the inclined direct-acting type. The trial trip was in charge of Mr. Arthur H. Folger, manager of the Lockwood Manufacturing Co.

The United States civil service commission announces that on Dec. 7 and 8 examinations will be held for the following positions: Inspector of hulls on steam vessels at $1,200 per annum at Cincinnati; two vacancies in the position of assistant inspector of hulls at $2,000 per annum at New York city; a vacancy in the position of local inspector of hulls at $2,250 per annum at Boston. The age is from 25 to 55 years and is open to all citizens of the United States. As examination papers are shipped directly from the commission to the places of examination it is necessary that application be received in ample time to arrange for the examination desired at the place indicated by the applicant. The commission will, therefore, arrange to examine any applicant whose application is received in time to permit the shipment of the necessary papers.

A report from the directors of the Blohm & Voss Ship Building Co. of Hamburg, one of the large German concerns, shows that during the year just closed the average number of hands employed was 3,752, against 4,216 in the previous twelve months. In the course of the year three steamers of, altogether, 17,415 registered tons gross and 8,550 I. H. P., a large cruiser for the imperial navy, and a floating dock for own account of 17,500 tons capacity were finished and delivered, and at the commencement of the current year there remained in hand another large cruiser, five steamers, and a floating dock for foreign account. In the year 1902-3 the work delivered comprised seven steamers and one sailing ship, the total gross register tonnage being 32,622 tons, and the total engine power 15,300 I. H. P. After writing off a sum for depreciation and making additions to the various funds, there remained for the past year a surplus of 541,921 marks, against 626,421 marks for the previous year, and the dividend is 7 per cent, against 9 per cent. The share capital is 6,000,000 marks, and there are priority bonds to the amount of 2,100,000 marks. The reserve fund is 600,000 marks.

VOL. XXX. CLEVELAND, O., NOVEMBER 24, 1904. No. 21.

After four years of investigation, the Boiler Committee appointed by the British Admiralty have unanimously declared that water tube boilers are more suitable for Naval purposes than cylindrical, and have again placed THE BABCOCK & WILCOX at the head of all types.

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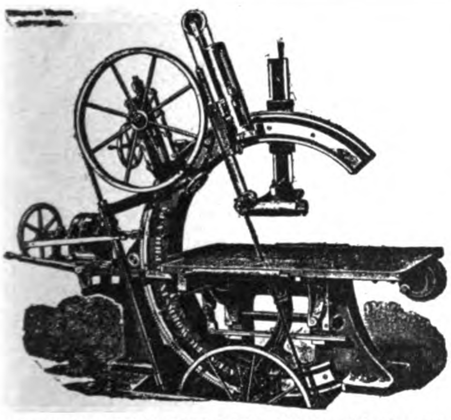

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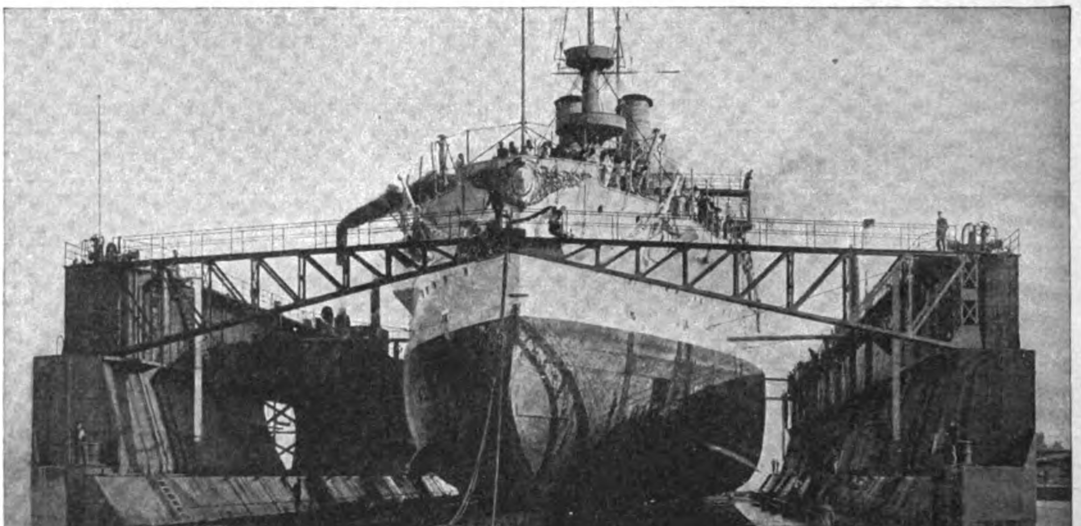

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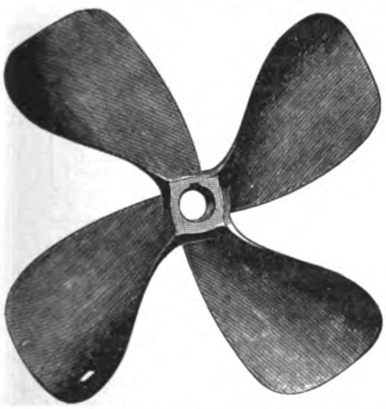

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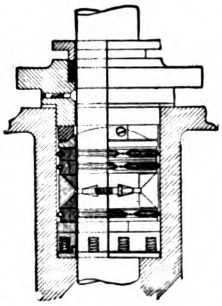

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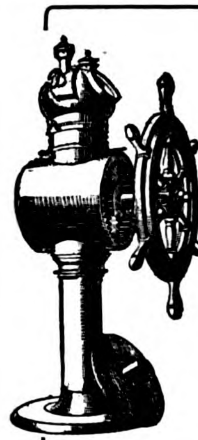

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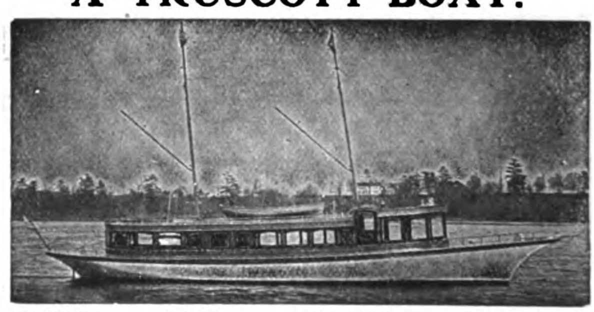

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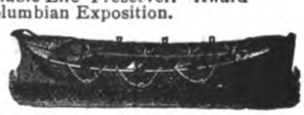

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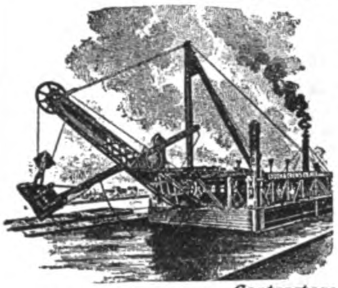

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Phil Sheridan, Steel.
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Derrick.
Faugh a Ballaugh.

Scows.

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Reciprocity,	600	yds., Steel.
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No. 6,	600	
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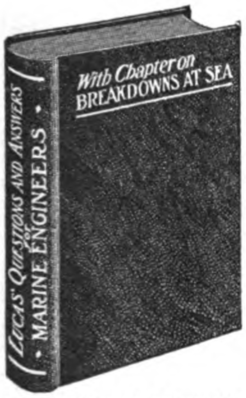

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SECOND REVISED EDITION

In this second edition in response to numerous requests, the publishers have added several subjects under the headings "Various Principles of Mathematics Useful to the Engineer and Machinist," the United States regulations relating to the examination of Engineers for licenses as Chief First, Second and Third Engineers, prescribed by the Board of Supervising Inspectors, an introduction relating to the Qualifications and Opportunities for entering the Government and Mercantile Marine Engine Room Service.

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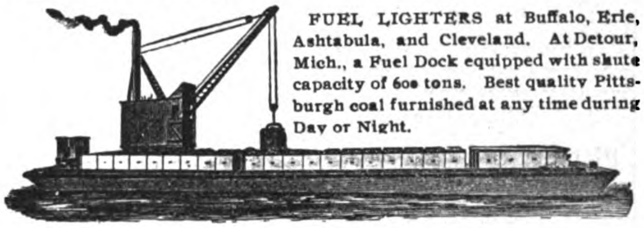

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For a more complete classification than that represented by advertisers in the Marine Review, see the BLUE BOOK OF AMERICAN SHIPPING, marine and naval directory of the United States, published by the Marine Review, 39-41 Wade Bldg., Cleveland.

See accompanying index of Advertisers for full addresses of concerns in this directory.

AIR COMPRESSORS, AIR HOISTS, ETC.
Dake Engine Co.........Grand Haven, Mich.
Great Lakes Engineering Works......Detroit.
Mietz, Aug. ....New York.

AIR PORTS, DEAD LIGHTS, ETC.
Marine Mfg. & Supply Co........New York.

AIR PUMPS AND APPLIANCES.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.

ANCHORS.
Baldt Anchor Co................Chester, Pa.
Bowers, L. M. & Co......Binghamton, N. Y.
DeGrauw, Aymar & Co............New York.
Seaboard Steel Casting Co.......Chester, Pa.

ANTI-FOULING AND ANTI-CORROSIVE COMPOSITION FOR STEEL VESSELS.
Holzapfel's American Composition Co..New York.

ANTI-FRICTION METALS.
Cramp, Wm. & Sons............Philadelphia.
Victor Metals Co............Braintree, Mass.

ARTIFICIAL DRAFT FOR BOILERS.
American Ship Building Co........Cleveland.
Detroit Ship Building Co............Detroit.
Great Lakes Engineering Works......Detroit.
Sturtevant, B. F., Co.........Hyde Park, Mass.

ASH EJECTORS.
Great Lakes Engineering Works......Detroit.

ATTORNEYS AND PROCTORS IN ADMIRALTY.
Gilchrist, Albert J.................Cleveland.
Goulder, Holding & Masten........Cleveland.
Hoyt, Dustin & Kelley............Cleveland.
Kremer, C. E......................Chicago.
MacDonald, Ray G.................Chicago.
Potter & Potter ....Buffalo.
Shaw, Warren, Cady & Oakes........Detroit.
White, Johnson, McCaslin & Cannon Cleveland.

BAROMETERS, MARINE GLASSES, ETC.
Ritchie, E. S. & Sons........Brookline, Mass.

BELTING, RUBBER.
New York Belting & Packing Co....New York.

BLOCKS, SHEAVES, ETC.
Boston & Lockport Block Co....Boston, Mass.
Cleveland Block Co................Cleveland.

BLOWERS.
Sturtevant, B. F. Co. ....Hyde Park, Mass.

BOAT BUILDERS.
Drein, Thos. & Son........Wilmington, Del.
Kahnweiler's Sons, David.........New York.
Lane & DeGroot ....Long Island City, N. Y.
Marine Construction & D. D. Co........
........Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co....St. Joseph, Mich.
Willard, Chas. P. & Co.............Chicago.

BOILER COMPOUNDS.
Dearborn Drug & Chemical Works....Chicago.

BOILER MANUFACTURERS.
Almy Water Tube Boiler Co.Providence, R. I.
American Ship Building Co........Cleveland.
Atlantic Works ....East Boston, Mass.
Babcock & Wilcox Co.............New York.
Bertram Engine Works Co., Ltd. ....
.............................Toronto, Can.
Chicago Ship Building Co..........Chicago.
Cramp, Wm. & Sons...............Philadelphia.
Delauney, Belleville & Co..St. Denis, France.
Detroit Ship Building Co............Detroit.
Fletcher, W. A. & Co........Hoboken, N. J.
Fore River Shipbuilding Co ....Quincy, Mass
Georgian Bay Engineering Works.......
.................................Midland, Ont.
Great Lakes Engineering Works......Detroit.

BOILER MANUFACTURERS—Continued.
Jenks Ship Building Co....Port Huron, Mich.
Kingsford Foundry & Machine Works....
..........................Oswego, N. Y.
Maryland Steel Co......... Sparrows Point, Md.
Milwaukee Dry Dock Co..........Milwaukee.
Mosher Water Tube Boiler Co....New York.
Newport News Ship Building Co........
......................Newport News, Va.
New York Shipbuilding Co.........Camden, N. J.
Northwestern Steam Boiler & Mfg. Co....
.........................Duluth, Minn.
Roberts Safety Water Tube Boiler Co....
.... New York.
Stirling, The Co....................Chicago.
Superior Ship Building Co....Superior, Wis.
Taylor Water Tube Boiler Co........Detroit.
Union Machine & Boiler Co........Cleveland.
United States Ship Building Co....New York.
Willard, Chas. P. & Co.............Chicago.

BOILER RIVETS.
Bourne-Fuller Co.. . ...Cleveland.

BOILER STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

BRASS AND BRONZE CASTINGS.
Cramp, Wm. & Sons............Philadelphia.
Fore River Ship & Engine Co..Quincy, Mass.
Great Lakes Engineering Works......Detroit.
Lunkenheimer Co. ....Cincinnati.
Macbeth Iron Co..................Cleveland.
Victor Metals Co............Braintree, Mass.

BRIDGES, BUILDERS OF.
Scherzer Rolling Lift Bridge Co....Chicago.

BUCKETS, ORE AND COAL.
Brown Hoisting & Conveying Machine Co.
.... Cleveland.
Macbeth Iron Co. ....Cleveland.
McMyler Mfg. Co....................Cleveland.

CABIN AND CABINET FINISHING WOODS.
Martin-Barriss Co.................Cleveland.

CAPSTANS.
American Ship Windlass Co..Providence, R. I.
Hyde Windlass Co................Bath, Me.
Marine Mfg. & Supply Co........New York.

CEMENT, IRON FOR REPAIRING LEAKS.
Smooth-On Mfg. Co........Jersey City, N. J.

CHAINS.
Lebanon Chain Works..........Lebanon, Pa.

CHAIN HOISTS.
Boston & Lockport Block Co....Boston, Mass.
Dake Engine Co.........Grand Haven, Mich.

CHARTS.
Penton Publishing Co. ....Cleveland.
Potter, J. D.........................London.

CLOCKS (Marine and Ship's Bell) AND CHRONOMETERS.
Ashton Valve Co.....................Boston.
Ritchie, E. S. & Sons........Brookline, Mass.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

COAL PRODUCERS AND SHIPPERS.
Hanna, M. A. & Co.............Cleveland.
Pickands, Mather & Co............Cleveland.
Pittsburg Coal Co..............Cleveland.

COAL AND ORE HANDLING MACHINERY.
Brown Hoisting Machinery Co. (Inc.) ..
.... Cleveland.
Macbeth Iron Co..................Cleveland.
McMyler Mfg. Co..... .... Cleveland.

COMPASSES.
Ritchie, E. S. & Sons........Brookline, Mass.

COMPOSITIONS FOR SHIP'S BOTTOMS.
Holzapfel's American Compositions Co.New York.

CONCRETE MIXERS.
Contractors Supply & Equipment Co..Chicago.

CONDENSORS.
Great Lakes Engineering Works.. Detroit.
Thropp & Sons Co., John E....Trenton, N. J.

CONTRACTORS SUPPLIES.
Contractors Supply & Equipment Co., Chicago.

CONTRACTORS FOR PUBLIC WORKS.
Buffalo Dredging Co.................Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.
.... Chicago.
Dunbar & Sullivan Dredging Co......Buffalo.
Fitz-Simons & Connell Co...........Chicago.
Hickler Bros. ....Sault Ste. Marie, Mich.
Lake Superior Contracting & Dredging Co.,
.........................Duluth, Minn.
Smith Co., L. P. & J. A...........Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Sullivan, M. ....Detroit.

CORDAGE.
Baker & Co., H. H.................Buffalo.
DeGrauw, Aymar & Co..........New York.
Upson-Walton Co...................Cleveland.

CORK JACKETS AND RINGS.
Armstrong Cork Co............Pittsburg, Pa.
Kahnweiler's Sons, D............New York.

COURSE FINDER.
Field's Patent Course Finder......Cleveland.

CHAIN CONVEYORS, HOISTS.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.
General Electric Co........Schenectady, N. Y.
Westinghouse Electric & Mfg. Co.......
..........................Pittsburg, Pa.

CRANES, TRAVELING.
Brown Hoisting Machinery Co.....Cleveland.
McMyler Mfg Co. ....Cleveland.
Pawling & Harnischfeger..........Milwaukee.

DIVING APPARATUS.
Morse, A. J. & Son..................Boston.
Schrader's Son, A................New York.

DREDGING CONTRACTORS.
Buffalo Dredging Co................Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co..
.... Chicago.
Dunbar & Sullivan Dredging Co......Buffalo.
Fitz-Simons & Connell Co...........Chicago.
Hickler Bros. ....Sault Ste. Marie, Mich.
Lake Superior Contracting & Dredging Co..
.........................Duluth, Minn.
Smith Co., L. P. & J. A...........Cleveland.
Starke Dredge & Dock Co., C. H..Milwaukee.
Sullivan, M. ....Detroit.

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Sturtevant, B. F., Co.........Hyde Park, Mass.

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American Ship Building Co........Cleveland.
Atlantic Works ....East Boston, Mass.
Buffalo Dry Dock Co................Buffalo.
Chicago Ship Building Co...........Chicago.
Craig Ship Building Co..........Toledo, O.
Cramp, Wm. & Sons...........Philadelphia.
Detroit Ship Building Co............Detroit.
Great Lakes Engineering Works......Detroit.
Lockwood Mfg. Co.........East Boston, Mass.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co........
....................Newport News, Va.
Shipowners Dry Dock Co........Chicago.
Superior Ship Building Co....Superior, Wis.

Buyers' Directory of the Marine Trade.—*Continued.*

ELECTRIC HOISTS AND CRANES.

Fisher Electrical Works..................Detroit.
General Electric Co.........Schenectady, N. Y.
Pawling & Harnischfeger.........Milwaukee.
Westinghouse Electric & Mfg. Co........
.... Pittsburg, Pa.

ELECTRIC LIGHT AND POWER PLANTS.

Fisher Electrical Works..................Detroit.
General Electric Co.........Schenectady, N. Y.
Mietz, Aug. ....New York.
Sturtevant, B. F. Co.........Hyde Park, Mass.
Thropp & Sons, John E.........Trenton, N. J.
Westinghouse Electric & Mfg. Co......
.... Pittsburg, Pa.

ENGINE BUILDERS, MARINE.

American Ship Building Co.........Cleveland.
Atlantic Works ....East Boston, Mass.
Bertram Engine Works Co., Ltd. ....
.... Toronto, Can.
Chicago Ship Building Co..........Chicago.
Chase Machine Co..................Cleveland.
Cramp, Wm. & Sons............Philadelphia.
Craig Ship Building Co..........Toledo, O.
Dake Engine Co.........Grand Haven, Mich.
Detroit Ship Building Co............Detroit.
Fletcher, W. & A. Co..........Hoboken, N. J.
Fore River Shipbuilding Co.........Quincy, Mass.
Great Lakes Engineering Works Detroit, Mich.
Hall Bros. ....Philadelphia.
Jenks Ship Building Co....Port Huron, Mich.
Lockwood Mfg. Co.........East Boston, Mass.
Macbeth Iron Co..................Cleveland.
Maryland Steel Co...........Sparrows Point Md.
Mietz, Aug. ....New York.
Milwaukee Dry Dock Co..........Milwaukee.
Mosher, Chas. D.................New York.
Moulton Steering Engine Co......New York.
Newport News Ship Building Co........
.....................Newport News, Va.
New York Shipbuilding Co.......Camden, N. J.
Northwestern Steam Boiler & Mfg. Co....
..........................Duluth, Minn.
Roach's Ship Yard ....Chester, Pa.
Sheriffs Mfg. Co..................Milwaukee.
Superior Ship Building Co....Superior, Wis.
Thropp, J. E. & Sons Co......Trenton, N. J.
Trout, H. G..........................Buffalo.
Willard, Chas. P. & Co.............Chicago.

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Cory, Chas. & Son................New York.
Marine Mfg. Supply Co...........New York.

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Kreer & Parsons.....................Chicago.

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Lunkenheimer Co. ....Cincinnati.
New York Belting & Packing Co..New York.
Northwestern Steam Boiler & Mfg. Co....
...........................Duluth, Minn.

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Hynd, Alexander ....Cleveland.
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Kidd, Joseph ....Duluth, Minn.
Kreer & Parsons......................Chicago.
Lovejoy, H. O.........................Buffalo.
Matteson & Drake ....Philadelphia.
Mosher, Chas. D....................New York.
Nacey, James ....Cleveland.
Rice, Henry ....Buffalo.
Roelker, H. B....................New York.
Sadler, Perkins & Field...........New York.
Wood, W. J. ....Chicago.

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Reilly Repair and Supply Co., Jas......New York.
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Westinghouse Electric & Mfg. Co......
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Sturtevant, B. F. Co................Boston.

FORGINGS FOR CRANK, PROPELLER OR THRUST SHAFTS, ETC.

Cleveland City Forge & Iron Co....Cleveland.
Fore River Shipbuilding Co.........Quincy, Mass.
Macbeth Iron Co..................Cleveland.

FLUE WELDING.

Fix's, S. Sons ....Cleveland.

FUEL ECONOMIZERS.

Sturtevant Co., B. F............Hyde Park, Mass.

FUELING COMPANIES AND COAL DEALERS.

Hanna, M. A. & Co..............Cleveland.
Ironville, Dock & Coal Co.........Toledo, O.
Parker Bros. Co., Ltd.............Detroit.
Picklands, Mather & Co...........Cleveland.
Pittsburg Coal Co...................Cleveland.
Smith, Stanley B., & Co..............Detroit.
Smith Coal & Dock Co., Stanley B.Toledo, O.

FURNACES FOR BOILERS.

Continental Iron Works...........New York.

GASKETS, RUBBER.

New York Belting & Packing Co..New York.

GAS BUOYS.

Safety Car Heating & Lighting Co..New York.

GAS AND GASOLINE ENGINES.

Chase Machine Co................Cleveland.
Georgian Bay Engineering Works.......
.... Midland, Ont.
Reliance Mfg. Co.............. Providence, R. I.

GAUGES, STEAM AND VACUUM.

American Steam Gauge & Valve Mfg. Co.
.... Boston.
Ashton Valve Co....................Boston.
Lunkenheimer Co. ....Cincinnati.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

GAUGES, WATER.

Bonner & Co., Wm. T................Boston.
Lunkenheimer Co. ....Cincinnati, O.
Standard Gauge Mfg. Co.....Syracuse, N. Y.

GRAPHITE.

Dixon Crucible Co., Joseph..Jersey City, N. J.

HAMMERS, STEAM.

Chase Machine Co................Cleveland.

HEATING APPARATUS.

Sturtevant, B. F. Co.......Hyde Park, Mass.

HOISTS FOR CARGO, ETC.

American Ship Building Co........Cleveland.
Brown Hoisting Machinery Co. (Inc.)....
.... Cleveland.
Chase Machine Co.................Cleveland.
General Electric Co..............New York.
Georgian Bay Engineering Works.......
.... Midland, Ont.
Hyde Windlass Co.................Bath, Me.
McMyler Mfg. Co.................... Cleveland.
Marine Iron Co......................Bay City.
Mietz, Aug. ....New York.
Pawling & Harnischfeger ....Milwaukee.
Westinghouse Electric & Mfg. Co........
.........................Pittsburg, Pa.

HOLLOW STAYBOLT IRON.

Falls Hollow Staybolt Co...Cuyahoga Falls, O.

HOSE, RUBBER.

New York Belting & Packing Co..New York.

HYDRAULIC DREDGES.

Great Lakes Engineering Works......Detroit.

HYDRAULIC TOOLS.

Watson-Stillman Co., The........New York.

ICE MACHINERY.

Great Lakes Engineering Works......Detroit.
Roelker, H. B....................New York.

INDICATORS FOR STEAM ENGINES.

American Steam Gauge Co............Boston.
Ashton Valve Co.....................Boston.

INJECTORS.

American Injector Co................Detroit.
Crane Co. ....Chicago.
Jenkins Bros. ....New York.
Lunkenheimer Co. ....Cincinnati.
Penberthy Injector Co..........Detroit, Mich.

INSURANCE, MARINE.

Elphicke, C. W. & Co..............Chicago.
Fleming & Co., P. H...............Chicago.
Frankfort Marine, A. & P. G. Ins. Co....
.... New York.

INSURANCE, MARINE—Continued.

Gilchrist & Co., C. P..............Cleveland.
Hawgood & Co., W. A.............Cleveland.
Helm & Co., D. T....................Duluth.
Hutchinson & Co..................Cleveland.
McCarthy, T. R....................Montreal.
McCurdy, Geo. L....................Chicago.
Mitchell & Co......................Cleveland.
Parker Bros. Co., Ltd...............Detroit.
Peck, Chas. E. & W. F..New York & Chicago.
Prindiville & Co.....................Chicago.
Richardson, W. C...................Cleveland.
Sullivan, D. & Co....................Chicago.
Voss, F. D.........................New York.

IRON ORE AND PIG IRON.

Bourne-Fuller Co...................Cleveland. O.
Hanna, M. A. & Co.................Cleveland.
Pickands, Mather & Co............Cleveland.

LAMPS, INCANDESCENT.

Westinghouse Elec. & Mfg. Co.....Pittsburg, Pa.
Sawyer-Man Electric Co. ....Pittsburg, Pa.

LAUNCHES—STEAM, NAPHTHA, ELECTRIC.

Georgian Bay Engineering Works........
.... Midland, Ont.
Marine Construction & D. D. Co........
..........Mariner's Harbor, S. I., N. Y.
Truscott Boat Mfg. Co......St. Joseph, Mich.
Willard, Chas. P....................Chicago.

LIFE PRESERVERS, LIFE BOATS, BUOYS.

Armstrong, Cork Co...............Pittsburg.
Drein, Thos. & Son..........Wilmington, Del.
Kahnweiler's Sons, D. ....New York

LIGHTS, SIDE AND SIGNAL.

Russell & Watson ....Buffalo.

LOGS.

Walker & Sons, Thomas ....Birmingham, Eng.
Also Ship Chandlers.

LUBRICATING GRAPHITE.

Dixon Crucible Co., Joseph..Jersey City, N. J.

LUBRICATORS.

Crane Co. ....Chicago.
Lunkenheimer Co. ....Cincinnati.

LUMBER.

Martin-Barriss Co.................Cleveland.

MACHINISTS.

Chase Machine Co................Cleveland.
Hickler Bros. ....Sault Ste. Marie, Mich.
Lockwood Mfg. Co........East Boston, Mass.
Macbeth Iron Co..................Cleveland.
Union Machine & Boiler Co......Cleveland.

MACHINE TOOLS (WOOD WORKING).

Atlantic Works, Inc............Philadelphia.

MARINE RAILWAYS.

Hickler Bros. ....Sault Ste. Marie, Mich.

MARINE RAILWAYS, BUILDERS OF.

Crandall & Son, H. I....East Boston, Mass.

MATTRESSES, CUSHIONS, BEDDING.

Fogg, M. W......................New York.

MECHANICAL DRAFT FOR BOILERS.

American Ship Building Co......Cleveland.
Detroit Ship Building Co............Detroit.
Great Lakes Engineering Works ..Detroit.
Sturtevant, B. F. Co.......Hyde Park, Mass.

METALLIC PACKING.

Katzenstein, L. & Co...........New York.

METAL POLISH.

Bertram's Oil Polish Co.............Boston

MOTORS, GENERATORS—ELECTRIC.

Fisher Electrical Works..............Detroit.
General Electric Co......Schenectady, N. Y.
Sturtevant, B. F. Co...... Hyde Park, Mass.
Westinghouse Electric & Mfg. Co.......
.... Pittsburg, Pa.

Buyers' Directory of the Marine Trade.—*Continued.*

NAUTICAL INSTRUMENTS.
Ritchie, E. S., & Sons........Brookline, Mass.

NAUTICAL SCHOOLS.
Chicago Nautical School. ...... Chicago.

NAVAL ARCHITECTS.
Hynd, Alexander ....Cleveland.
Kidd, Joseph..................Duluth, Minn.
Kreer & Parsons. .... Chicago.
Lovejoy, H. O......................Buffalo.
Matteson & Drake..............Philadelphia.
Mosher, Chas. D.................New York.
Nacey, James ....Cleveland.
Rice, Henry ....Buffalo.
Sadler, Perkins & Field...........New York
Wood, W. J.........................Chicago.

OAKUM.
DeGrauw, Aymar & Co............New York.
Stratford, Oakum Co......Jersey City, N. J.

OIL ENGINES.
Mietz, Aug. ....New York.

OILS AND LUBRICANTS.
Dixon Crucible Co., Joseph..Jersey City, N. J.
Standard Oil Co..................Cleveland.

PACKING.
Crane Co. ....Chicago.
Jenkins Bros. ....New York.
Katzenstein, L. & Co..............New York.
New York Belting & Packing Co...New York.

PACKING TOOL.
Matteson & Drake ....Philadelphia.

PAINTS.
Baker, Howard H. & Co............Buffalo.
Detroit Varnish Co..................Detroit.
Detroit White Lead Works...........Detroit.
New Jersey Zinc Co...............New York.
Upson-Walton Co. ....Cleveland.

PATTERN SHOP MACHINERY.
Atlantic Works, Inc..............Philadelphia.

PILE DRIVING AND SUBMARINE WORK.
Buffalo Dredging Co...............Buffalo.
Chicago & Gt. Lakes Dredge & Dock Co.. .... Chicago.
Dunbar & Sullivan Dredging Co.....Buffalo.
Fitz-Simons & Connell Co...........Chicago.
Hickler Bros. ....Sault Ste. Marie, Mich.
Lake Superior Contracting & Dredging Co.. ....Duluth, Minn.
Parker Bros. Co., Ltd...............Detroit.
Smith Co., L. P. & J. A............Cleveland.
Starke Dredge & Dock Co., C. H...Milwaukee.
Sullivan, M. ....Detroit.

PIPE, WROUGHT IRON.
Bourne-Fuller Co. ....Cleveland, O.
Crane Co. ....Chicago.
Macbeth Iron Co ....Cleveland.

PLANING MILL MACHINERY.
Atlantic Works, Inc..............Philadelphia.

PLATES—SHIP, STRUCTURAL, ETC.
Bourne-Fuller Co. .... Cleveland O.
Otis Steel Co......................Cleveland.

PNEUMATIC TOOLS.
Allen, John F.....................New York.

POLISH FOR METALS.
Bertram's Oil Polish Co..............Boston.

PRESSURE REGULATORS.
Kieley & Mueller ....New York.
Ross Valve Co...................Troy, N. Y.

PROPELLER WHEELS.
American Ship Building Co.........Cleveland.
Atlantic Works ....East Boston, Mass.
Cramp, Wm. & Sons............Philadelphia.
Detroit Ship Building Co............Detroit.
Fore River Shipbuilding Co ....Quincy, Mass.
Great Lakes Engineering Works.. ....Detroit.
Hyde Windlass Co...................Bath, Me.
Jenks Ship Building Co....Port Huron, Mich.
Lockwood Mfg. Co.........East Boston, Mass.
Macbeth Iron Co...................Cleveland.
Milwaukee Dry Dock Co..........Milwaukee.
Newport News Ship Building Co.......... ....Newport News, Va.
Phosphor Bronze Smelting Co., Ltd....... ....Philadelphia.
Roelker, H. B.....................New York.
Sheriffs Mfg. Co..................Milwaukee.
Superior Ship Building Co....Superior, Wis.
Thropp & Sons Co., J. E.......Trenton, N. J.
Trout, H. G.......................Buffalo.
United States Ship Building Co....New York.

PROJECTORS, ELECTRIC.
General Electric Co......Schenectady, N. Y.
Westinghouse Electric & Mfg. Co...... ....Pittsburg, Pa.

PUMPS FOR VARIOUS PURPOSES.
Blake, Geo. F., Mfg. Co..........New York.
Great Lakes Engineering Works ......Detroit.
Kingsford Foundry & Machine Works.... ....Oswego, N. Y.

PUNCHES, RIVETERS, SHEARS.
Allen, John F. ....New York.

RANGES.
Russell & Watson ....Buffalo

REFRIGERATING APPARATUS.
Great Lakes Engineering Works......Detroit.
Roelker, H. B. ....New York.

REGISTER FOR CLASSIFICATION OF VESSELS.
Great Lakes Register ....Cleveland.
Record of American & Foreign Shipping.. ....New York.

REPAIRS—ENGINE AND BOILER.
(See also Boiler Manufacturers and Engine Builders.)
Georgian Bay Engineering Works....... ....Midland, Ont.

RIVETING MACHINES.
Allen, John F.....................New York.

RIVETS, STEEL FOR SHIPS AND BOILERS
Bourne-Fuller Co..................Cleveland, O.

SAFETY VALVES.
American Steam Gauge & Valve Mfg. Co. .... Boston.
Ashton Valve Co....................Boston.
Crane Co. ....Chicago.
Lunkenheimer Co. ....Cincinnati.

SAIL MAKERS.
Baker, Howard H. & Co............Buffalo.
Upson-Walton Co.................Cleveland.
Wilson & Silsby ....Boston.

SALVAGE COMPANIES.
See Wrecking Companies.

SCHOOLS—NAVIGATION.
Chicago Nautical School................Chicago.

SEARCH LIGHTS.
General Electric Co........Schenectady, N. Y.
Westinghouse Electric & Mfg. Co....... ....Pittsburg, Pa.

SHEARS.
See Punches, Rivets, and Shears.

SHIP AND BOILER PLATES AND SHAPES.
Bourne Fuller Co. ....Cleveland, O.
Otis Steel Co.....................Cleveland.

SHIP BUILDERS.
American Ship Building Co.........Cleveland.
Atlantic Works ....East Boston, Mass.
Bertram Engine Works Co., Ltd.Toronto, Can.
Buffalo Dry Dock Co................Buffalo.
Cramp, Wm. & Sons............Philadelphia.
Craig Ship Building Co..........Toledo, O.
Chicago Ship Building Co...........Chicago.
Detroit Ship Building Co............Detroit.
Fore River Shipbuilding Co ......Quincy Mass.
Great Lakes Engineering Works......Detroit.
Jenks Ship Building Co....Port Huron, Mich.
Lockwood Mfg. Co........East Boston, Mass.
Maryland Steel Co...........Sparrows Point, Md.
Milwaukee Dry Dock Co.........Milwaukee.
Newport News Ship Building Co....... ....Newport News, Va.
New York Shipbuilding Co.........Camden, N. J.
Roach's Ship Yard ....Chester, Pa.
Shipowner's Dry Dock Co...........Chicago.
Smith & Son, Abram..........Algonac, Mich.
Willard, Chas. P. & Co............Chicago.

SHIP CHANDLERS.
Baker, Howard H. & Co.. ....Buffalo.
Marine Mfg. & Supply Co........New York.
Upson-Walton Co.................Cleveland.

SHIP DESIGNERS.
Kidd Joseph ....Duluth.
Kreer & Parsons. ....Chicago.
Matteson & Drake ....Buffalo.
Rice & Lovejoy.........................Buffalo.
Steel, Nacey & Hynd ....Cleveland.
Wood, W. J ....Chicago.

SHIP LANTERNS AND LAMPS.
Russell & Watson ....Buffalo.

SHIP TIMBER.
Martin-Barriss Co.................Cleveland.

SMOOTH-ON COMPOUND, FOR REPAIRS.
Smooth-On Mfg. Co...........Jersey City, N. J.

STAYBOLTS, IRON OR STEEL, HOLLOW OR SOLID.
Falls Hollow Staybolt Co..Cuyahoga Falls, O.

STEAM VESSELS FOR SALE.
Gilchrist & Co., C. P. ....Cleveland.
Holmes, Samuel ....New York.
Lester, S. S. .... Quebec, Can.
McCarthy, T. R...............Montreal, Can.

STEAMSHIP LINES, PASS. AND FREIGHT.
American Line ....New York.
Anchor Line ....Buffalo.
Boston Steamship Co ....Boston.
Cleveland & Buffalo Transit Co.......Cleveland.
Detroit & Cleveland Line.............Cleveland.
Erie & Western Trans. Co...........Buffalo.
Goodrich Trans. Co..................Chicago.
International Mercantile Marine Co....... ....Philadelphia.
Manitou Steamship Co...............Chicago.
Mexican-American S. S. Co..New Orleans, La.
New York & Cuba Mail S. S. Co..... New York
Niagara, St. Catharines & Toronto Ry. & Nav. Co. ....St. Catharines, Ont.
Northern Michigan Trans. Co.........Chicago.
Red Star Line ....New York.
Richelieu & Ontario Nav Co. ...Montreal, Can.
United Fruit Co ....Boston.

STEEL CASTINGS.
Macbeth Iron Co...................Cleveland.
Otis Steel Co......................Cleveland.

STEERING APPARATUS.
American Ship Building Co........Cleveland.
Chase Machine Co.................Cleveland.
Dake Engine Co.........Grand Haven, Mich.
Detroit Ship Building Co............Detroit.
Hyde Windlass Co.................Bath, Me.
Jenks Ship Building Co....Port Huron, Mich.
Marine Mfg. & Supply Co..........New York.
Moulton Steering Engine Co......New York.
Pawling & Harnischfeger ....Milwaukee.
Sheriffs Mfg. Co. ....Milwaukee.

SUBMARINE DIVING APPARATUS.
Morse & Son, A. J..................Boston.
Schrader's Son, A...............New York.

SURVEYORS, MARINE.
Gaskin, Edward ....Buffalo.
Hynd, Alexander ....Cleveland.
Lovejoy, H. O ....Buffalo.
Matteson & Drake ....Philadelphia.
Parker Bros. Co., Ltd................Detroit.
Nacey, James ....Cleveland.
Rice, Henry ....Buffalo.
Steel, Adam ....Cleveland.
Wood, W. J..........................Chicago.

TESTS OF MATERIALS.
Hunt, Robert W. & Co..............Chicago.

TILING, INTERLOCKING RUBBER.
New York Belting & Packing Co...New York.

TOOLS, METAL WORKING, FOR SHIP AND ENGINE WORKS.
Allen, John F.....................New York.
Watson-Stillman Co................New York.

TOOLS, WOOD WORKING.
Atlantic Works, Inc............Philadelphia.

TOWING MACHINES.
American Ship Windlass Co..Providence, R. I.
Chase Machine Co.................Cleveland.

TOWING COMPANIES.
Donnelly Salvage & Wrecking Co....... ....Kingston, Ont.
Great Lakes Towing Co..........Cleveland.
Midland Towing & Wrecking Co., Ltd.... ....Midland, Ont.

TRAPS, STEAM.
Kieley & Mueller ....New York.
Lunkenheimer Co. ....Cincinnati.
Sturtevant Co., B. F., ...Hyde Park Mass.

TRUCKS.
Boston & Lockport Block Co........Boston.

TUBING, SEAMLESS.
Shelby Steel Tube Co........Pittsburg, Pa.

Buyers' Directory of the Marine Trade.—*Continued.*

ALPHABETICAL INDEX OF ADVERTISERS IN THE MARINE REVIEW.

The star (*) indicates that the advertisement appears alternate weeks. For addresses see advertisements on pages noted.
The dagger (†) indicates that advertisement appears once a month.

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To an outsider the care taken in selecting material and the way the material is worked into shape in building WATSON-STILLMAN JACKS it might look as if they are made a little better than seems necessary.

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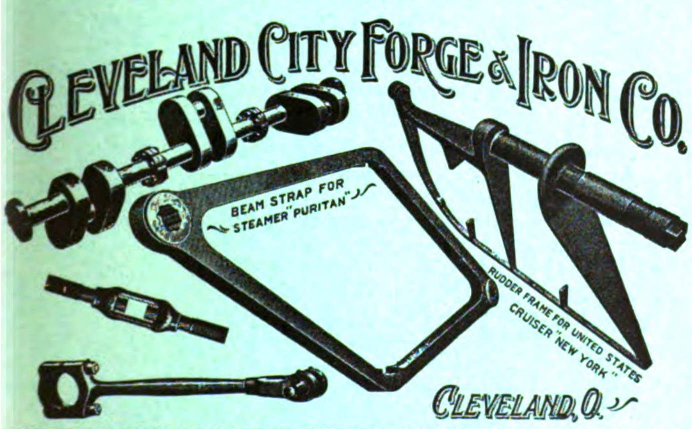

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Eastward	Arrive from West	Depart East
No. 18, Southwestern Limited		*1:50 a.m.
No. 22, Lake Shore Limited	*2:12 a.m.	*2:20 a.m.
No. 20, Chicago and Cleveland Exp.	*7:20 a.m.	
No. 28, New York and Boston Exp.	*7:40 a.m.	*8:00 a.m.
No. 40, Toledo and Buffalo Accom	†10:00 a.m.	†10:30 a.m.
No. 32, Fast Mail	*11:25 a.m.	*11:30 a.m.
No. 48, Accommodation via Sandusky	†1:40 p.m.	
No. 42, Boston-New York Express		*11:45 a.m.
No 44, Cleveland and New York Spl		*3:00 p.m.
No. 46, Southwestern Express		*3:10 p.m.
No. 116, Ashtabula Accommodation		†4:30 p.m.
No. 6, Limited Fast Mail	*5:40 p.m.	*5:45 p.m.
No 26, 20th Century Limited	*7:40 p.m.	*7:43 p.m.
No. 10, Chicago, N.Y. & Boston Spl.	*7:30 p.m.	*7:50 p.m.
No. 16, New England Express	*10:30 p.m.	*10:35 p.m.
No. 2, Day Express	†9:10 p.m.	†9:25 p.m.
No. 126, Norwalk Accommodation	†7:55 a.m.	
Westward	**Arrive from East**	**Depart West**
No. 7, Exposition Limited	*12:50 a.m.	
No. 11, Southwestern Limited	*2:55 a.m.	
No 9, Day Express		†6:10 a m.
No. 15, Boston and Chicago Special	*3:10 a.m.	*3:15 a.m.
No. 19, Lake Shore Limited	*7:15 a.m.	*7:25 a.m.
No. 23, Western Express	*10:30 a.m.	*10:35 a m.
No. 29, Southwestern Special	‡11:10 a.m.	
No 33, Southwestern Express	*12:25 p.m.	
No. 133, Cleveland and Detroit Exp.		*12:45 p.m.
No. 47, Accommodation	†11:00 a.m.	†3:00 p m.
No. 141, Sandusky Accommodation		†3:10 p m.
No. 43, Fast Mail	*4:35 p.m.	*4:40 p.m.
No. 127, Norwalk Accommodation		†5:10 p.m.
No. 37, Pacific Express	*6:50 p.m.	*7:20 p m.
No. 3, Fast Mail Limited	*10.50 p.m.	*10:55 p.m.
No 115, Ashtabula Accommodation	*8.30 a.m.	

*Daily. †Except Sunday. ‡Except Monday.
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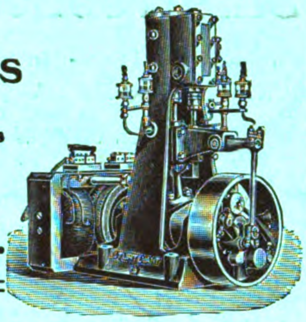

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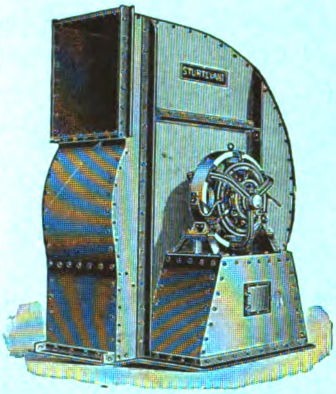

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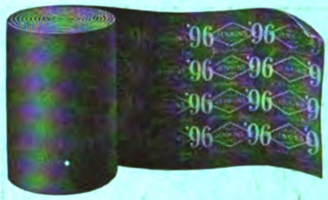

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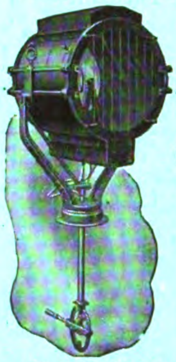

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